FOURTEENTH ANNUAL

16

REPORT

OF

Rutgers Scientific School,

THE STATE COLLEGE

FOR THE

BENEFIT OF AGRICULTURE AND MECHANIC ARTS,

NEW BRUNSWICK, N. J.,

FOR THE YEAR 1878.

TRENTON, N. J.:
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Board of Visitors.

First Congressional District.

	Residences.	*Terms Expire.*
Hon. THOMAS H. DUDLEY,	Camden,	April 12, 1880.
CHALKLEY ALBERTSON, Esq.,	Haddonfield,	April 12, 1880.

Second Congressional District.

Hon. WILLIAM PARRY,	Cinnaminson,	April 12, 1879.
EDWARD J. C. ATTERBURY, Esq.,	Trenton,	April 12, 1880.

Third Congressional District.

Hon. WILLIAM A. NEWELL,	Allentown,	April 12, 1880.
JAMES NEILSON, Esq.,	New Brunswick,	April 12, 1880.

Fourth Congressional District.

JOHN DEMOTT, Esq.,	Middlebush,	April 12, 1879.
WM. R. JANEWAY, Esq.,	Franklin Township,	April 12, 1880.

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CORNELIUS P. GARRABRANT, Esq.,	Mendham,	April 12, 1880.
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Sixth Congressional District.

PATRICK T. QUINN, Esq.,	Newark,	April 12, 1880.
WILLIAM M. FORCE, Esq.,	Newark,	April 12, 1879.

Seventh Congressional District.

ABRAHAM S. DURYEA, Esq.,	New Durham,	April 12, 1880.
Prof. ALBERT K. LEEDS,	Hoboken,	April 12, 1880.

OFFICERS.

Hon. WILLIAM PARRY, *Chairman.*
Prof. GEORGE H. COOK, *Secretary.*

Report of State Board of Visitors.

FOURTEENTH ANNUAL REPORT OF THE BOARD OF VISITORS OF THE STATE AGRICULTURAL COLLEGE.

To His Excellency Geo. B. McClellan, Governor of the State of New Jersey:

Sir—The Board of Visitors of the State Agricultural College herewith present the fourteenth annual report on the present condition of the College, with such considerations and recommendations as are contemplated in the act creating the board, which act is entitled "An act appropriating script for public lands granted to the State of New Jersey by the act of Congress approved July 2d, 1862," and approved April 4th, 1864.

In accordance with the law, the board has held two meetings at the College during the present year; and a committee of the board has also visited the College Farm.

The first meeting was held at the College, December 14th, 1877, at which nine of the fourteen members of the board were present. The examinations attended at that time were as follows:

Senior Class—Prof. Bowser, in Mechanics.
" Prof. Van Dyck, Chemical Physics.
Junior Class—Prof. Meyer, German.
" Prof. Atherton, Political Economy.
Sophomore Class—Prof. Hasbrouck, Descriptive Geometry.
" Prof. Van Dyck, Chemistry.
" Prof. Atherton, History.
Freshman Class—Prof. Meyer, French.

The students in Analytical Chemistry were also examined in their work in the laboratory, under the instruction of Dr. Austen.

At the meeting after the examinations, a full interchange of opinions was had, and the board expressed its approval of the manner in which the Trustees of Rutgers College were carrying out their pledges made to the State when they accepted this United States Government grant for the endowment of an Agricultural College.

At this meeting also, Messrs. Newell, Janeway and Albertson,

a committee to visit the College Farm, reported that they had discharged their duty, and that the crops, tillage and stock were in excellent condition, and the new barn and newly-arranged out-buildings were great and satisfactory improvements, and the farm is fast taking its place as a model for the farmers of the State.

The second meeting of the board was held at the College, June 14th, 1878, and seven of the fourteen members were present.

The members of the board attended the examination of classes, and, at their meeting held in the President's room afterwards, reported that they had heard Prof. Bowser's classes examined in Railroad Engineering and in Integral Calculus; Prof. Hasbrouck's classes in Descriptive Geometry; Prof. Van Dyck's classes in Botany; Prof. Meyer's classes in French and German.

These were examinations of the Juniors, Sophomores and Freshmen.

The drawings of all the classes, executed under Prof. Hasbrouck's instructions, were examined and highly approved. The students of Analytical Chemistry were also found to be in course of thorough training in that science, under Dr. Austen.

At the meeting held at the close of the examination, after a discussion of the results of their observations, the following resolution was passed, viz:

"*Resolved*, That we have attended, with great pleasure and satisfaction, the examinations of the several classes, and that we heartily endorse the action of the President and Faculty, which has produced such results."

In the afternoon the board met in Kirkpatrick Chapel to hear the graduating theses of the Senior Class. These were upon subjects of engineering and chemical science which the students had investigated for themselves, and for which they had prepared their own drawings and illustrations. The following named students read theses:

John Bishop, New Brunswick, N. J., the construction of canal locks;

Henry M. Herbert, New Brunswick, N. J., the precipitation of strychnine with hydrogen sulphide;

Edward Duryee, Rahway, N. J., clays;

F. T. Lent, Poughkeepsie, N. Y., the drainage question;

W. L. Lawrence, Hamburgh, N. J., the manufacture of iron by the indirect process:

Robert W. Prentiss, Brooklyn, N. Y., the iron railroad bridge over the Raritan at New Brunswick.

This last was awarded the prize for superior excellence. The members present expressed their unqualified approbation of the performances of the young men, and ordered the following resolution to be entered on the minutes:

"*Resolved*, That we have listened with great pleasure and interest to the theses of the graduating class, and are at a loss which most to admire, their perfect knowledge of their subjects, or the masterly manner in which they have handled them; and we congratulate their instructors on the results of their labor in training these young men."

Messrs. Newell, Demott, Janeway and Quinn, with Mr. Neilson, who was not present at this meeting, visited the College Farm in May, and report that they were highly pleased with everything connected with it. The crops promise a large return; the stock is in fine condition, and everything about the establishment shows that it is well conducted.

This farm was bought, put in good order and stocked by the Trustees of Rutgers College, in obedience to the State law which required them to erect adequate buildings, and "to furnish and provide a suitable tract of land, conveniently located, for an experimental farm," "without charge to or upon the State." As directed by the State law, all the income arising from the fund obtained by the sale of the Congressional land grant is applied wholly and exclusively to the maintenance of the courses of instruction, which have been established by the trustees and approved by this board.

No money has ever been received as yet from New Jersey towards the establishment or support of this Agricultural College. In many of the States which received similar grants from Congress, the funds thus created have been supplemented liberally by grants from the States themselves. The experimental farm cannot now be used for experiments unless additional means are provided to pay the cost. Farms can be carried on, and, with economy and skill, made to pay more than their expenses. But if they are used for experiments, which require time, skill and money, they cannot meet their expenses. Experience in our own country, but much more in Europe, has shown that experimental farms and experiment stations have met the wants of progressive agriculture more satisfactorily than any other plan which has been devised.

The Agricultural College Farm, and the laboratories of the College, happily supply the necessary location and appliances for a first-class agricultural experiment station, and we recommend that a sufficient appropriation be made for this purpose; and a committee of this board is authorized to proceed to Trenton and urge the necessary Legislative action.

The members of the board who have been longest in office bear testimony to the value of the education given in this school of science. The department of Mixed Mathematics is excellent, and has been from the first; that of Chemistry is constantly growing, and the Analytical Laboratory, which is well appointed, is filled with students who are very zealous to become accom-

plished chemists. The collections in Geology, Mineralogy, Zoology and Botany are large and constantly growing, and those of Technology and Agriculture are respectable.

Students who have been educated here are mainly engaged in industrial, scientific or professional pursuits, and their chances for success and usefulness in those pursuits are greatly increased by their education. The benefits of a course in the College are so highly appreciated in some counties that there are many more applications than scholarships; there are other counties from which no students have ever applied for admission.

Of the forty free scholarships belonging to the State only twenty are now filled. If information in regard to the College were more generally diffused, it must be that these vacant scholarships would all be filled. We consider them so valuable to the State that we recommend that authority be given to the board to advertise vacancies in scholarships, examinations of students, &c., and that the expenses therefor be paid out of the State treasury.

All of which is respectfully submitted.

WILLIAM PARRY,
President of the State Board of Visitors.

Trustees' Report.

Rutgers College,
New Brunswick, Nov. 22, 1878

To His Excellency, George B. McClellan, Governor of the State of New Jersey:

Sir: In compliance with the act of Congress, approved July 2, 1862, and the act of the Legislature of New Jersey, approved April 4, 1864, I beg leave to submit, on behalf of the Trustees of Rutgers College, the fourteenth annual report of Rutgers Scientific School.

I. THE FACULTY.

The Faculty of the Institution remains the same as at the date of the last annual report, except that the Department of Natural Science has been strengthened by the appointment of Dr. Peter Townsend Austen as Assistant Professor of Chemistry. The Faculty is now constituted as follows:

Rev. Wm. H. Campbell, D. D., LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President, and Professor of Chemistry, Natural History and Agriculture.

Rev. Theodore S. Doolittle, D. D., Professor of Rhetoric, Logic and Mental Philosophy.

John C. Smock, A. M., Professor of Mining and Metallurgy.

George W. Atherton, A. M., Professor of History, Political Economy and Constitutional Law.

Rev. Carl Meyer, D. D., Professor of French and German.

Francis C. Van Dyck, A. M., Professor of Analytical Chemistry.

Edward A. Bowser, M. S., C. E., Professor of Mathematics and Engineering.

Isaac E. Hasbrouck, A. M., Professor of Mathematics and Graphics.

George B. Merriman, A. M., Professor of Natural Philosophy and Astronomy.

Peter Townsend Austen, Ph. D., F. C. S., Assistant Professor of Chemistry.

II. COURSES OF STUDY AND DEGREES.

The courses of study in the Scientific School are as follows:

1. A course of four years in Civil Engineering and Mechanics.

2. A course of four years in Chemistry and Agriculture.

3. A special course of two years in Chemistry.

4. Post-Graduate Courses.

The SPECIAL COURSE in Chemistry is intended for the convenience of students who wish to devote themselves exclusively to that branch of study. Greatly increased facilities have recently been provided for them in the Laboratory and Lecture Rooms, allowing the full employment of their time. On completing the course, they receive a certificate to that effect.

Provision is also made for PARTIAL STUDENTS, who may enter at any time, and elect, under the advice and direction of the Faculty, such studies as they may be found qualified to pursue, with classes already formed. Such students are subject to the general regulations and discipline of the Institution. They are required to have their time fully occupied, and to pass such examinations as may be prescribed in each case. On leaving, they receive certificates stating the studies pursued and the amount of work performed in each.

The two principal courses cover a period of four years each. The studies of the first two years are the same in both courses, and are arranged with special reference to the wants of young men who desire to fit themselves to become land surveyors, or to enter any department of skilled industry, but are unable to remain four years in the Institution. Students who leave at the end of this short course, receive certificates.

At the end of the two years' course, students elect whether to pursue the course in Civil Engineering and Mechanics, or that in Chemistry and Agriculture, and for the remaining two years their studies are directed with particular reference to the choice made. Some studies, however, of a general nature, such as History, English Literature, Political Economy, Moral Philosophy and others are interspersed throughout the entire four years, in order that students may not only acquire a thorough preparation for their special pursuits in life, but may at the same time receive a liberal training which will fit them to discharge wisely and usefully, the duties of good citizenship.

Students completing either of the four years' courses, receive the degree of Bachelor of Science.

Heretofore, the degree of Master of Science has been conferred,

in course, upon all graduates of three years' standing. The Trustees have long been convinced that the practice of conferring high academical honors, indiscriminately, without regard to the character or attainments of those who receive them, is an unfair discrimination against those who have honorably earned recognition, and calculated to bring all such marks of distinction into undeserved discredit. They have accordingly decided to confer no degrees, "in course," after the Commencement in 1881, and they regard this as an important step in the direction of maintaining a high standard of scholarship.

The degrees of Civil Engineer and Doctor of Philosophy are conferred for distinguished professional or practical success, or, on examination in prescribed subjects.

A schedule of the several courses of study accompanies this report.

III. POST-GRADUATE STUDIES.

In addition to these courses of study for undergraduates, several post-graduate courses have been arranged (and the number will be increased as occasion requires), for students who desire, after graduation, to pursue special lines of training and research.

In Chemistry, students can pursue special studies and investigations in the Analytical Laboratory, under the direction of a professor, upon subjects connected with industrial or professional life.

In Geology and Natural History, the large collections in Geological Hall, are available for extended courses of study, and can be used under the direction of a professor for special study in Geology, Mining, Metallurgy and the various branches of Engineering.

In Agriculture, the well-equipped farm and laboratories give unusual opportunities for advanced studies in this department, and every facility is afforded for their use.

In Mathematics, instruction will be given in any of the following subjects: Geodesy, with practice; Higher Mathematics (pure); Theoretical aud Practical Astronomy; the use of Physical Apparatus.

In Modern Languages, the course will include Lectures on French Literature; Lectures on German Literature; Lectures on German Etymology, on German Mythology, and on the Phonology and Morphology of the Indo-Germanic Languages, as bearing on German.

In the department of Political and Social Science, provision is made for instruction in an Advanced Course in Political Economy; in the Constitutional History and Jurisprudence of the United States; in the History of the English Constitution; and in the elements of Roman Law.

These various subjects, according to the choice of students, will be arranged in courses of one, two or three years.

Students completing a full course of two years, in any two of the departments, will be entitled to the degree of Bachelor of Philosophy.

Students completing a full course of three years, in any three of the departments will be entitled to the degree of Doctor of Philosophy.

IV. TERMS OF ADMISSION.

The conditions of admission to the regular courses of study remain the same as for the last six years.

Applicants must be sixteen years of age, and of good moral character, and, if they come from other institutions, must bring a certificate of honorable dismission. They are required to pass a satisfactory examination in English Grammar and Spelling, Descriptive Geography, Physical Geography, History of the United States, Arithmetic, including the Metric System, Algebra to Equations of the second degree, and three books of Plane Geometry. The classes entering in September, 1879, and subsequently, will be examined in Algebra to Series; and in September, 1880, and subsequently, the whole of Plane Geometry will be required.

The regular examinations for admission to the Freshman Class are held on the Friday and Saturday preceding the annual commencement, and on the day before the opening of the Fall term. Candidates for advanced standing are examined in the preparatory studies, and in those already pursued by the class which they propose to enter.

V. STUDENTS.

Of the four classes now in the Institution, which will be graduated in June, 1879, 1880, 1881 and 1882, respectively, the Senior Class consists of seven students, the Junior Class of six, the Sophomore Class of eight, the Freshman Class of fourteen, and three special students, making a total of thirty-eight now in attendance.

There have been in the Institution, during the year, fifty-six students, of whom one was from Japan, two from the State of Pennsylvania, five from the State of New York, and the remaining forty-eight from the State of New Jersey, representing fifteen counties as follows:

Bergen............................	1	Morris............................	4
Cape May..........................	1	Ocean.............................	1
Essex.............................	1	Passaic...........................	1

Hudson	1	Somerset	2
Hunterdon	1	Sussex	1
Mercer	1	Union	5
Middlesex	22	Warren	1
Monmouth	5		

Under the law of New Jersey, designating this institution as "The State College for the Benefit of Agriculture and the Mechanic Arts," forty students from this State are entitled to free tuition for the entire course. These students are admitted on the recommendation of the Superintendent of Schools in each county, and are distributed among the counties in proportion to their representation in the Legislature, as follows:

Atlantic	1	Middlesex	2
Bergen	1	Monmouth	2
Burlington	3	Morris	2
Camden	2	Ocean	1
Cape May	1	Passaic	2
Cumberland	1	Salem	1
Essex	6	Somerset	1
Gloucester	1	Sussex	1
Hudson	6	Union	2
Hunterdon	1	Warren	1
Mercer	2		

In filling these State scholarships the Trustees have, from the first, adopted the most liberal interpretation of the law; and, in fact, have gone far beyond its requirements, as the following statement, repeated from their report of last year, will indicate:

"In cases where a scholarship is not filled by the county entitled to it, the Trustees have adopted the policy of allowing it to be filled temporarily, with the consent of the County Superintendent, by an applicant from some other county; and, in general, tuition is habitually remitted to students who are unable to pay that in addition to the other expenses of procuring an education."

The number of counties represented has been greater the past year than at any previous time since the institution was established, and the Trustees indulge the hope that this fact indicates a growing appreciation of its advantages, on the part of the people of the State.

The following tables, which have been prepared with great care by Professor Hasbrouck, present in a condensed form a complete exhibit of what has been done in the way of furnishing free tuition, since the institution was organized, together with a summary of attendance, by years and by counties:

I. Table showing the Number of Students Present by Counties, from the Beginning, for each Collegiate Year.

COUNTIES.	Scholarships.	COLLEGIATE YEARS.													
		1865–66.	1866–67.	1867–68.	1868–69.	1869–70.	1870–71.	1871–72.	1872–73.	1873–74.	1874–75.	1875–76.	1876–77.	1877–78.	1878–79.
Atlantic	1	......	......	......	......	......	......	......	1	1	1	1	......	......	......
Bergen	1	......	......	......	1	......	2	1	......	......	......	1	1	......	......
Burlington	3	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Camden	2	......	......	......	......	......	......	......	1	......	......	......	......	......	......
Cape May	1	......	......	......	......	......	......	......	......	......	......	......	......	......	1
Cumberland	1	......	1	1	......	2	2	2	......	......	......	......	......	......	......
Essex	6	2	2	3	5	6	6	3	2	1	3	4	2	1	......
Gloucester	1	......	......	......	......	......	1	1	1	1	1	......	......	......	......
Hudson	6	......	......	......	......	......	1	4	4	3	2	......	......	1	1
Hunterdon	1	......	......	......	......	......	......	1	1	1	1	1	1	......	1
Mercer	2	......	2	5	2	3	1	1	......	1	1	1	1	......	1
Middlesex	2	......	6	13	9	7	9	7	10	14	17	16	17	16	15
Monmouth	2	......	2	4	4	4	2	1	......	1	1	1	2	4	4
Morris	2	......	1	1	1	3	4	5	3	2	2	1	2	3	4
Ocean	1	......	......	......	......	......	......	1	1	1	......	......	......	......	1
Passaic	2	......	1	1	1	......	......	......	......	1	1	1	1	......	1
Salem	1	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Somerset	1	1	3	6	6	4	4	5	3	1	......	......	......	1	2
Sussex	1	1	1	......	......	......	......	......	......	......	......	1	1	1	......
Union	2	1	1	3	2	2	7	8	6	6	6	8	8	4	1
Warren	1	......	......	......	......	......	......	......	......	......	......	......	1	1	1
Total, New Jersey	40	5	20	37	31	31	39	40	33	34	34	36	37	32	33
Other States	......	2	3	6	7	5	10	14	11	14	14	9	6	7	5
Grand Total	......	7	23	43	38	36	49	54	44	48	48	45	43	39	38

II. Table showing the Relation of Students as to Tuition for each Collegiate Year from the Beginning.

COLLEGIATE YEARS.	NEW JERSEY.				Other States.	Grand Total.
	On Scholarship.	Free.	Pay.	Total.		
1865–66	1	2	2	5	2	7
1866–67	8	7	5	20	3	23
1867–68	13	17	7	37	6	43
1868–69	17	10	4	31	7	38
1869–70	15	13	3	31	5	36
1870–71	20	11	8	39	10	49
1871–72	18	15	7	40	14	54
1872–73	17	9	7	33	11	44
1873–74	14	15	5	34	14	48
1874–75	12	13	9	34	14	48
1875–76	15	13	8	36	9	45
1876–77	17	15	5	37	6	43
1877–78	14	12	6	32	7	39
1878–79	20	5	8	33	5	38

III. Table Showing the Number of Students from each County, from the Beginning, and their Relation as to Tuition.

COUNTIES.	Scholarship.	ON SCHOLARSHIPS. By appointment	By transfer.	Transfer'd from other Counties.	Free.	Pay.	Total.
Atlantic	1				1		1
Bergen	1	2			2		4
Burlington	3		2				
Camden	2	1	1				1
Cape May	1	1	1				1
Cumberland	1	2		1	1		3
Essex	6	12	2		6	2	20
Gloucester	1	2					2
Hudson	6	4	1		2	1	7
Hunterdon	1	3					3
Mercer	2	3			4		7
Middlesex	2	9		4	27	27	63
Monmouth	2	8		1	5	1	14
Morris	2	9		1	2	2	13
Ocean	1	3					3
Passaic	2	2			1		3
Salem	1		1				
Somerset	1	5		1	8	3	16
Sussex	1	1			1		2
Union	2	7			7	6	20
Warren	1	1					1
	40	75	8	8	67	42	184
Other States							56
Grand total							240

IV. Table Showing the Number of Students from each County at the present time, and their relation as to Tuition.

COUNTIES.	Scholarship.	ON SCHOLARSHIPS. By appointment	By transfer.	Transfer'd from other Counties.	Free.	Pay.	Total.
Atlantic	1						
Bergen	1						
Burlington	3		2				
Camden	2		1				
Cape May	1	1					1
Cumberland	1						
Essex	6		2				
Gloucester	1						
Hudson	6	1	1				1
Hunterdon	1	1					1
Mercer	2				1		1
Middlesex	2	5		3	3	7	15
Monmouth	2	3		1	1	1	4
Morris	2	3		1			4
Ocean	1	1					1
Passaic	2	1					1
Salem	1						
Somerset	1	2		1			2
Sussex	1						
Union	2	1					1
Warren	1	1					1
Total N. J.	40	20	6	6	5	8	33
Other States							5
Grand Total							38

V. Table showing the Occupation of 82 of the Students of Rutgers Scientific School who Graduated, and of 47 who left without Graduating, from the beginning to 1878, inclusive, these being the only ones whose occupation is certainly known.

STUDENTS.	OCCUPATIONS.							
	Eng'r.	Arch't.	Mftr	F'mer.	M. D.	Law'r.	T'ch'r.	Busn's
Who graduated	36	4	9	6	5	8	7	7
Per cent	44	5	11	7	6	10	8.5	8.5
Who did not graduate	5	2	6	7	4	3	2	18
Per cent	11	4¼	13	15	8.5	6	4¼	38
Total	41	6	15	13	9	11	9	25
Per cent.	32	5	12	10	7	8	7	19

VI. SPECIAL DEPARTMENTS.

The method and scope of work in the several departments of the institution have undergone no particular change since the date of the last report, though it is but just to the gentlemen in charge to say that there are in each department gratifying indications of steady and vigorous growth.

1. THE MATHEMATICAL COURSE.

In Mathematics, students during the first two years are occupied with Algebra, Geometry, Trigonometry, &c., and have sufficient field practice to make them familiar with the use of surveyors' instruments. Those who take what is known as the Engineering Course, for the full term of four years, are instructed in the various branches of higher Mathematics—Mechanics and Engineering—having, at the same time, daily practice in Draughting. The aim of the instruction is to make good draughtsmen, and to give the student a clear idea of the elements of the higher Mathematics, and a knowledge of the theory of engineering, so that, after graduation, he may be able to pursue, understandingly and continuously, an advanced course of mathematical study, or to go into the field or the office as an engineer's assistant, and do good, reliable work. For four years past, some students in this department have been employed on the Geodetic Survey of New Jersey. Having previously received instruction in the theory of Geodetic surveying, they are found to be worth far more, for practical work, than those who enter the fields without such instruction. This course does not aim to make practical engineers, but to lay the foundation on which alone practical success can be assured. During the past year there has been a post graduate class pursuing the study of higher

Algebra, Conic Sections, Solid Analytical Geometry, Higher Plane Curves and the Calculus, with very satisfactory results.

2. GRAPHICS.

The course in this subject will be found outlined in the "Courses of Study," and was more fully explained at page 14 of last year's report, to which reference is made. The plan there given has been, in the main, continued with increasingly satisfactory results. No text books are used, the problems being stated upon a black-board and the solutions obtained by the students at their drawing tables. The expense is thus materially lessened without impairing, it is thought, the quantity or the quality of the results obtained. The student is under the necessity of close attention to the explanations of the instructor; and also, being compelled to investigate for himself the conditions of the given problem and to elaborate and assimilate the knowledge obtained in his various mathematical studies, he makes his knowledge more full and accurate as well as himself more completely master of it.

Much time in the first year is still, unfortunately, of necessity spent in teaching the student the elementary processes of holding and using the right-line pen, the ruler, the triangle and the T-square. It may seem that these *apparently simple* details could be acquired in a brief lesson; but awkwardness not overcome after many exercises, crooked, uneven lines and badly arranged details and drawings, even after repeated trials, show that the student can no more become a good or even a fair draughtsman without the long practice and drudgery of simple methods in drawing simple lines, than he can learn to spell without learning the elements of the words to be spelled.

Although, as stated in the last report, the necessary arrangements of the course prevent more than an introduction to a few of the applications of drawing, still much is accomplished. The students are enabled to comprehend, to some extent, the meaning and requirements of practical questions in drawing, and to bring into use the necessary means to secure the end desired. In the office of the engineer or architect they have sufficient familiarity with methods and readiness of execution, to assure them at the outset a position of respect, if not of great responsibility, and to enable them more successfully and fully to respond to such demands as may subsequently be made upon them. If we cannot prepare students to take at once the superintendency of a pattern shop or to undertake the designing of a locomotive or the preparation of the plans for a cathedral or a man-of-war, we can at least equip him with knowledge and skill sufficient to render him a desirable assistant to the mechanical or civil engineer, to the house or naval architect, and to enable him more

rapidly to avail himself of the benefits afforded by the office of such a chief; and can give him the foundation on which to build from his observation and experience a comely and safe professional superstructure.

Many of the drawings of the past year evinced much proficiency in the art as well as mastery of the principles of drawing, and several have been added to the collection of students' work arranged upon the walls of the Draughting Room. The extensive and even elaborate drawings executed by some of the members of the last graduating class to accompany and illustrate their theses, secured special notice and commendation.

In the drawings, generally, the readiness in device for securing desired results for giving expression to abstract geometrical reasoning, and for resolving difficulties, show quickened as well as strengthened mathematical power.

Descriptive Geometry is taught with a text book as a guide to the student, and as furnishing him with nuclei about which he may arrange the knowledge acquired from oral instruction and his own researches. The problems assigned were of increased difficulty, and the readiness and neatness of the solutions, both in analysis and in construction, have been especially gratifying as indicative of increasing mathematical taste as well as knowledge. The work done here gives hopeful promise of what the student may accomplish, when, having chosen the direction in which he will apply his knowledge, he supplements by experience and observation the beginnings of *principle* and *practice* here secured.

The experience of the year has confirmed and emphasized some of the opinions and facts stated in the report of last year. Notably is this the case in the matter of elementary work and the training of the student in the Preparatory Schools. The disparity in ability for neat and rapid execution was never so marked between those students who have had a preliminary training in the rudiments of right-line drawing, and those who come to us without such training. Not only is the eye quicker, the judgment surer, and the hand more facile in the former case, but there is a more ready comprehension of the conditions of a problem, and of their relations to each other, and to the truths and methods before acquired, and which may be employed in the solution. Students are required to have at least an elementary knowledge of those subjects which they expect to pursue on entering a Technical or Scientific School. Why not in right-line drawing also? This elementary knowledge can be acquired more profitably in the Preparatory School than in the advanced School, when the relative value to the student of his time in the two Schools is properly estimated.

3. Chemistry and Physics.

These subjects are taught with increased fullness every year. Two hours per week are devoted to each branch of science, and ample time thereby given to the student to digest and assimilate each subject, presented in successive portions. Variety of occupation is also thus secured, with its well known advantages.

It is believed, as the result of careful inquiry, that no other institution, except professedly special schools, devotes so much time to instruction in Physical Science.

Students in all the courses of the school have six terms of lectures on Chemistry and Physics, and are required to take full notes, in order to train them in habits of accurate observation and facility of expression. During the three terms devoted to Inorganic Chemistry the theory of the subject is elucidated and its application to mining, manufactures and natural operations illustrated by numerous experiments.

Organic Chemistry is taught in the most practical manner possible, with direct reference to Agriculture, Medecine, Dietetics, etc.

The subjects of Heat, Light and Electricity are presented in their most modern aspects, all recent discoveries being noted in the lectures.

Three rooms in the Geological Hall are at present devoted to chemical analysis. These with the annexed balance room and store rooms and the general lecture room, occupy the first floor of the building.

Mention was made in the report for 1877 of an important addtion having been made to the working facilities of the departmeet, by devoting a separate room and special tables to Blowpipe Analysis. This study has, since then, been greatly developed. New desks of the latest and most approved form have been built to accommodate the continually increasing number of students. The course has been extended to the full limits of Qualitative Blowpipe Analysis, and the students are hence able to analyse complicated substances. An extensive stock of apparatus is kept on hand in the Supply Room, so that the student is able to use the most modern appliances in his analyses.

In beginning the study of Blowpipe Analysis, the student is first taught how to blow glass, and make much of his own apparatus. He is then made familiar with the properties of the various chemical elements by performing their characteristic tests, as laid down in the text book. Having become acquainted with the properties of the elements, he proceeds to analyse substances, or in other words to apply for the detection of the elements, the characteristic tests he has learned. In this manner he soon becomes expert at detecting even traces of the metals, etc. The

small size of the blowpipe and its apparatus, and the ease with which analyses are performed by its aid, make it an instrument of great value to the professional man, whether he be a mining engineer desirous of examining an ore in a part of the country where only a candle is obtainable, or a physician wishing to detect in a few minutes the presence of arsenic or mercury in a suspected substance.

Determinative Mineralogy has been made a special branch of instruction and is taken up after completion of Blowpipe Analysis. By the aid of the blowpipe and a few chemicals, the student is soon able to determine the nature of any mineral or ore.

The examinations in Blowpipe Analysis having been successfully passed, and the student having shown by an actual analysis of a test substance that he is a capable analyst, the study of Qualitative Analysis is entered upon. Here a far more complicated set of apparatus and chemicals is needed. While Blowpipe Analysis can detect only a limited number of substances, Qualitative Analysis includes all the elements. The student begins in the same manner as with the blowpipe. He performs the characteristic tests, and learns the manipulations. He soon enters upon actual analysis. From the most simple substances, he proceeds gradually to more difficult ones, until his analyses include the most complicated and difficult mixtures. Accompanying the practical work in the Laboratory, full courses of lectures are delivered on the subject, by which the student is given a clear idea of the theory of the subject. The course concludes with examinations in the theory and practice of analysis.

Quantitative Analysis now begins. While in his former studies the student has learned how to detect the constituents of a substance, he now learns how to determine their *amount*. Here he acquires the delicacy and accuracy of quantitative method, in which the slightest speck of matter represents a certain weight, and becomes familiar with the handling of costly instruments of precision. The course includes the analysis of minerals, ores, coals, metals, waters, fertilizers, wines, urine, poisons, etc.

In addition to the above subjects, a course in microscopical investigation will soon be added. A room is also being fitted up for a thorough course in practical assaying of ores, or fire analysis. In the Blowpipe, Qualitative and Quantitative Laboratories, improvements and extensions are constantly being introduced, which with the increasing stock of apparatus and chemicals will soon make them unsurpassed in thoroughness.

In the practical study of Analysis, the student is able to apply and carry out the theoretical principles of Chemistry which he has learned in his lectures on General Chemistry. The continual practice in detecting substances by their characteristic appearances under varying conditions, and the necessity in every case of rigid experimental proof, become habits applicable to all

things in actual life, and give the student a drilling and foundation in practical logical deduction and induction, that is of incalculable value to him.

The student concludes his course in the Laboratory, by undertaking an original experimental investigation on some point connected with theoretical or applied Chemistry. He now leaves the firm ground of known facts and methods and enters on the limitless fields of investigation and discovery. It is here that his enthusiasm is fully aroused, and his determination and energy display themselves. He discovers new facts, handles new substances, invents methods, originates expedients, and learns the value and power of discovery. Failures only incite him to effort. Perseverance and determination to succeed become habitual to him.

It is in this field that the most strenuous efforts are being made toward development, for it is by this advanced teaching alone, that the student can be made to think and act for himself, place confidence in his own powers and raise himself by *original* thought and work in the profession he adopts.

The Professors in charge, allow a free reference to their own books, and the College library is open daily for consultation. The fundamental idea of the plan of instruction is to make the students independent, by teaching them not only what a routine analyst ought to know, but also the proper use of the books upon the subject. Inasmuch as many students in the regular course intend to pursue Medicine, Agriculture, etc., and hence will not be likely to make analyses themselves, they are taught also to know when and how to have analyses made, and shown how the habits of exactness and system acquired in a Laboratory are important elements of mental training.

Special students in Chemistry are, of course, required to spend much more time at work, in order to acquire greater facility. We have good reason to believe that any one, on leaving the Laboratory after a full course, is competent to devote himself, with success, to any line of business connected with Chemistry, without further need of instruction. Certain it is that medical students invariably say that their course at College has proved invaluable to them. By degrees it is becoming more evident to the public that a rapid and thorough development of the industrial resources of our country, demand not only a trained class of original workers, but a spread of scientific information among the masses, in order that opportunities for employing specialists to advantage may not pass unobserved.

Practical chemists must necessarily spend most of their time in the Laboratory. The farmers and men engaged in industrial pursuits generally, ought to know what chemists can do, and ought to be able to judge pretty nearly when a chemist's aid is

advantageous. The aim, then, is to teach analysis, both as a means of educational discipline and as a profession.

There are now thirty-six students engaged in Chemical Analysis, of whom three are special students.

4. THE MUSEUM.

The Museum of the College occupies the second and third stories of Geological Hall, consisting of one large room with galleries and store rooms at the south end. The main room is ninety by forty and twenty-five feet high. Large windows on both sides and at the north end give an abundance of light, and so distribute it that everything is exhibited to the best advantage. On each side, under the galleries, there are seven double cases, so placed as to make an alcove at each window. These are sufficiently large to admit narrow, open cases in front of each window, whenever additional space for the exhibition of specimens is demanded. These side cases contain drawers below and shelves above. The former serve for the storage of duplicates, the latter hold those on exhibition. The cases on the east side are devoted to Mineralogy and Metallurgy. Of these, one is filled with a complete collection of minerals for the use of students of Mineralogy. They furnish material for use in blowpipe analysis, for the ordinary chemical examinations, and for the illustration of the general principles of Mineralogy, as crystallization, &c. Here are small suites showing degrees of hardness, electrical characters, magnetic properties, cleavage, &c. Three of the side cases are filled with larger and better examples of minerals, arranged according to the system of Dana. These can be studied, under special arrangements, by more advanced students. The collection is good and equal to the wants of elementary instruction, and for post graduates to an advanced position. Three cases are filled with ores of the various metals—one containing iron ores, a second those of zinc (including handsome specimens from the celebrated mines of Sterling Hill and Franklin Furnace), and the third with native gold and silver, and ores of copper, lead, nickel, antimony and other metals. Among the copper compounds there is a very fine collection from the mines of Chili, South America, the gift of Miss Evans of New Brunswick.

The west side cases hold a part of the Paleontological and Geological collections, grouped according to their age. One case contains specimens which illustrate the formation and structure of rocks. These occupy the shelves and are always to be seen by the student of Geology. Below them is a suite of five hundred specimens from Dr. Krantz, of Bonn, also for students' use. They represent by typical examples all the geological ages and periods and give a general notion of the succession of the formations of the

earth. In the remaining cases the characteristic rocks and fossils of the Silurian, Devonian, Carboniferous, Triassic, Cretaceous and Tertiary and Recent ages are so arranged that the various changes in the condition of the earth and its animal and vegetable life, are traced from the eozoon of the Archaic rocks to the frail shells that are to-day filling up our lakes and marshes with shell marl. Two large glass cases in the centre of the room, a recent gift of Hon. A. Q. Garretson, Jersey City, contain typical specimens of the rocks, ores, marls, clays, sands and other native minerals of New Jersey, which are used in manufactures and agriculture. This collection is largely a duplicate of that exhibited by the Geological Survey at the Centennial Exposition at Philadelphia. It presents to the view of the student the varied natural resources of a State. Another case on the main floor is filled with mastodon remains. These are: a very large tusk from Ellenville, New York, and a skeleton from Salem county, New Jersey. As soon as the necessary funds are procured it is designed to set up this skeleton, which, when mounted, will be the most striking object in the Museum.

For illustrating iron working, two collections are particularly noticeable. One of these is a collection of T-irons from the Trenton Iron Company; the other a similar collection of T-irons, and of rails, from the Union Iron Company, of Buffalo, New York. Many other Metallurgical specimens in iron, zinc, copper, lead, nickel, silver, and gold, show how these metals are obtained from their ores, and form a valuable nucleus for a Metallurgical cabinet.

The few specimens of recent birds and animals occupy two large cases. This very important department is in need of large additions.

The conchological collection has been classified and beautifully arranged, by George W. Tryon, of Philadelphia, in a series of flat cases running around the sides of the gallery. The collection is large, and equal to the needs of the most advanced collegiate course. It is well filled with the most characteristic species and genera of living mollusks.

The most conspicuous object in the Museum is the skeleton of the whale which was caught in the Raritan river three years ago, and which Sheriff E. F. Roberts very generously gave to the College. Prof. F. C. Van Dyck and D. C. Van Dyck, a former student of the Scientific School, mounted this skeleton, suspending it in the centre of the room, near the level of the gallery floor. It illustrates on a large scale to the student of anatomy the mamamalian skeleton, and becomes a type in a series of such forms.

A human skeleton, the gift of Prof. J. S. Mosher, M. D., of the Albany Medical College, and a former student of Rutgers, serves for the study of human anatomy.

Since the last annual report was published two large and handsome cases have been placed on the main floor. These are the gifts of Hon. Jonathan Dixon, and the Beck cabinet of minerals has been transferred to one of them. In this new case this unique and valuable collection shows to advantage, and in an appropriate and peculiar manner testifies to the diligence of Dr. Beck as a collector and mineralogist. Aside from its intrinsic importance, it will serve to call up pleasant recollections of this distinguished scientist, so long connected with the college. In the other case there are collections of typical rocks, illustrative of the geological formations of the Auvergne district of France, and flint implements and associated fossil remains from the celebrated fluviatile beds at Amiens. These collections are the gift of Dr. Cook.

One of the most interesting and valuable donations to the Museum during the year is a mastodon tusk, four feet long, which was found in the gravel formation at Trenton. It was presented to the college by E. F. Brooks, of the class of 1872.

The Indian antiquities and other ethnological material have been arranged in one of the cases of the main floor. The collection is small, but contains valuable relics, and shows the character of the remains of our aboriginal population.

A collection of the native woods of New Jersey has recently been placed in a new case in the south gallery. It numbers about one hundred pieces, and exhibits nearly all of the more common woods found growing in our State. Some additional specimens are still much needed to make it full and representative.

The case room of the Museum is inadequate to the proper display of materials in store, and two additional floor cases are wanted to fill up the main room, besides smaller cases for the galleries in which to place zoological and botanical specimens.

These statements indicate an increase in the attractive objects of the collection, as well as in valuable specimens for aid in object teaching; but the wants of the Museum are still large, since no collection is too full for the complete survey of any department of natural history, although quite adequate to the more limited requirements of the ordinary college student; but for a scientific school and for specialists, it cannot outgrow their needs.

VII. THE AGRICULTURAL DEPARTMENT AND STATE FUND.

The operations of the Agricultural Department during the past year are set forth in the accompanying report of the professor in charge.

The amount of money received from the State Treasurer for

the fiscal year ending October 31st, 1878, is six thousand nine hundred and sixty dollars ($6,960), which has been expended, as the law requires, exclusively for the salaries of professors in the Scientific School.

Respectfully submitted,

WM. H. CAMPBELL,

President of the Board of Trustees.

Report on the College Farm.

ANNUAL REPORT ON THE FARM OF THE STATE AGRICULTURAL COLLEGE FOR THE YEAR 1877-8.

BY GEO. H. COOK.

THE SEASONS AND WEATHER.

The year just passed has been favorable to all staple farm crops, although it has been marked by extremes of temperature and an unusually small rainfall. A severe frost occurred May 13, which did much damage to potatoes, and injured slightly the corn and grain. Subsequent planting and the favoring weather made up most of the damage to those crops. The greatest injury by the frost was to the fruit. The grape was much injured by it, and in the southeastern part of the State the crop was entirely destroyed. The peach and apple crop were affected to some extent. In Ocean and the counties farther south, the young leaves of the forest trees were killed. The summer was very hot, but the intense and long-continued heat period did not cause any drought, as the rains were timely. These kept the vegetation green and promoted a luxuriant and healthy growth, so that August seemed like June, judging from the foliage and fields. In consequence of these favoring conditions, the grass was very heavy and the pasture abundant. Corn also did well, and the yield was large. The winter grain, where not hurt by the Hessian fly, was above the average, and the oat crop was unusually heavy. The potatoes of late planting were generally good. The latter part of the season was quite dry, and diminished the turnip crop to some extent.

The annual rainfall at New Brunswick is shown in the following table for the years 1854-1878, inclusive. The records up to 1869 were made at the College; those for 1869-1875 by P. Vanderbilt Spader, Esq., at his residence, corner of George and Church streets; and those for 1875-1878 at the College Farm.

TABLE OF RAINFALL AT NEW BRUNSWICK FOR TWENTY-FIVE YEARS.

MONTH.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	Monthly Average
January	2.00	3.05	3.73	3.48	3.30	4.43	2.61	3.81	5.37	4.16	1.66	3.00	1.65	0.64	3.88	3.49	4.53	4.14	1.70	5.33	4.33	3.64	0.91	2.03	2.43	3.26
February	4.82	2.51	0.79	1.18	1.91	3.23	1,60	1.92	2.63	3.32	0.46	4.15	4.76	6.01	2.20	5.84	4.88	3.77	1.66	3.72	2.90	3.84	3.37	1.22	4.17	3.06
March	1.16	1.80	3.01	0.97	1.90	6.04	0.80	3.50	3.70	5.04	3.79	3.98	1.68	2,38	2.05	4.87	4.36	5.09	4.19	2.39	2.06	4.30	5.10	5.66	2.42	3.21
April	9.22	2.21	3.76	6.24	4.01	4.56	1.85	5.05	3.58	5.30	3.76	2.31	3.08	1.99	4.99	1.62	5.87	3.22	2.15	5.12	8.25	2.84	2.37	3.18	1.38	3.98
May	4.12	3.54	3.24	5.10	4.80	1.82	5.63	5.52	1.93	3.11	6.12	6.10	4.30	6.45	7.57	5.18	3.15	3.50	2.45	4.26	1.85	1.77	2.49	1.10	3.52	4.01
June	3.65	4.83	1.83	3.71	0.24	4.68	2.28	2.52	6.81	1.80	1.95	1.42	2.91	10.90	6.41	5.57	5.91	5.90	3.85	3.88	3.05	4.56	0.82	5.35	4.27	4.10
July	3.63	3.17	1.92	4.20	2.85	3.47	2.72	1.26	5.74	10.42	1.59	7.73	2.91	5.03	6.26	3.61	4.66	8.91	8.97	9.47	4.02	3.94	1.59	2.67	5.13	4.76
August	1.48	2.48	6.03	6.16	3.00	4.88	11.52	3.04	1.13	3.45	3.13	3.08	7.07	8.45	3.55	0.70	6.70	9.25	7.12	10.79	2.35	8.08	0.76	4.54	2.59	5.02
September	2.67	2.66	4.71	3.35	1.54	7.20	4.32	2.41	2.80	0.98	4.07	2.51	5.84	0.34	7.59	2.34	3.68	2.39	3.01	3.59	8.61	2.19	6.04	1.40	2.23	3.41
October	1.70	3.84	0.90	3.91	2.01	1.81	3.02	2.59	5.20	3.12	2.27	4.45	3.83	4.18	1.34	8.53	5.60	5.51	4.09	4.65	2.66	2.62	.70	6.38	3.15	3.64
November	3.21	2.48	2.98	0.00	3.56	3.58	6.27	8.77	5.11	2.29	4.47	3.41	2.61	1.68	4.94	3.76	1.91	4.19	4.04	4.35	2.44	4.37	3.63	6.71	2.99	3.53
December	2.39	5.81	3.17	5.93	4.23	3.97	3.44	1.90	1.13	5.12	4.82	5.95	2.83	1.27	3.32	4.86	2.34	2.31	4.70	2.40	2.78	2.76	3.43	0.96	......	3.66
Total for the year	40.05	38.38	36.07	41.23	33.35	49.67	46.06	42.29	45.12	48.11	38.03	48.09	43.47	49.32	54.10	50.37	52.99	58.18	47.93	59.95	45.30	44.88	30.33	41.20	......	3.80

Greatest annual rain fall	59.95
Least annual rain fall	30.33
Yearly average for 24 years	45.23
Greatest monthly rain fall	11.52
Least monthly rain fall	0.00
Average monthly rain fall	3.80

From this table it appears that the annual rain fall for the years 1874–5–6 and 7 has been below the average for the whole series covered by these records. 1876 was unusually dry. Last year was also dry, especially the Winter and Spring months. The rain fall from April 1st to November 1st of the present year, which was the season of plant growth, was 22.27 inches. The average aggregate for these seven months is 29.21 inches. Although the total rain fall was so much below the usual amount, the rains came at timely intervals and were not heavy. This distribution through the season kept the vegetation in fine growing condition. The longest interval without any measurable rain fall was from May 9th to May 31st,—twenty-two days; from August 16th to September 1st,—sixteen days, and from September 26th to October 18th,—twenty-two days. The largest amount of any single storm was May 31st, when the rain fall was 1.94 inches; the next largest was October 18th, when there was a fall of 1.54 inches.

FARM CROPS.

Wheat.—Two fields, one of twelve and the other of five acres, were in this crop. The twelve acre field is immediately west and south of the dwelling, and is one of the best on the farm. Nine acres of it was sown with Fultz wheat, and the crop was two hundred and forty-nine bushels, being an average of twenty-seven and two-thirds bushels to the acre. The remaining three acres were sown with Clawson wheat. This, though sown at the same time with the other and on quite as good ground, suffered more from the fly than the Fultz, and did not yield so heavy a crop. The grain, however, was not kept separate from that of the five acre field, which was all in Clawson wheat. The latter field had been in corn, and the wheat was put in after it, on account of getting the ground in grass, like the remaining part of the field. The whole crop of Clawson wheat was only ninety-six bushels, or an average of twelve bushels to the acre.

The whole of both fields had a light dressing of superphosphate of lime.

Rye.—This grain was grown on a small field of two acres. It was very heavy and badly lodged. It has not been threshed out but it will not be as large a crop as we have had in some former years. The part threshed indicates a yield of about thirty-five bushels an acre.

Oats.—This crop was sown on eight acres of our last year's corn ground. Of this field, six acres were of the White Canada oats, the seed of which was sent by the Department of Agriculture, last year. It is a much heavier grain than our common

oats, yields a larger crop, and ripens two or three days earlier. The whole crop amounts to three hundred and seventy-five bushels, which is forty-seven bushels an acre, nearly.

Corn.—The principal corn field contains twelve acres. It is the last field brought into cultivation, and is not yet thoroughly improved. It has been in meadow for three years past. The corn was planted on the inverted sod and grew well, and yielded nearly one thousand bushels of ears of corn. About an acre was planted with Sugar corn, the seed of which was obtained from David Pettit, of Salem. It is remarkable for a large yield and quick growth. An acre of this, fertilized with twenty loads of barnyard manure, yielded considerably over one hundred bushels of shelled corn to the acre.

Potatoes.—Four acres of the last year's corn ground were planted in potatoes. From this field a crop of three hundred and forty bushels was dug. A half acre was planted with seed from Maine that had probably been heated on the way, so that though the potatoes were sound they would not grow, and the crop on that part was a failure. This leaves the crop about one hundred bushels an acre on the remainder of the field.

Mangold Wurzels.—This root crop was grown on two acres of ground, which were manured heavily. The seed did not come up very well, and the frequent rains made the weeds grow so as to be very troublesome. The crop was six hundred and seventy-six bushels, or three hundred and thirty-eight bushels an acre.

A few rows were planted with the seeds of the large Blood beet. They did not come up well, but the beets which grew were larger, and apparently more thrifty than the Mangolds. The milk of the cows fed on them is red, and we cannot use them as feed for dairy cows.

Silesian Sugar Beets were grown on one-tenth of an acre, from seed sent from Germany. They grew well, and made a crop as good in appearance as those grown in Germany or France. The yield was forty-two bushels, or four hundred and twenty bushels an acre. The percentage of sugar in them has not been tested.

Carrots.—Two acres of Carrots were grown, and the crop was a very fair one of seven hundred and thirty-three bushels, or three hundred and sixty-six bushels an acre. The Carrots are not quite as smooth as usual, and a much larger proportion than usual have seeded the first year. This is probably owing to some peculiarity of the season.

Ruta Baga Turnips.—Three-quarters of an acre were planted with this crop. The ground was not very rich, but was well manured.

The dry weather checked the growth of the turnips, and the yield was only one hundred and twenty bushels.

Yellow Globe Turnips.—An acre and a half was planted to this crop, and the yield was three hundred and fifty-five bushels. These turnips grow quickly and require less labor to keep them free from weeds than either carrots or beets, and as feed for cattle are probably cheaper than either of the others.

Cabbage.—An acre and a quarter was planted to this crop, and a little over four thousand heads of cabbage have been marketed. The season has been favorable.

Hay.—Twenty-five acres of meadow have been mown this year, and fifty-five loads of hay were put in the barn. These may safely be estimated to be equal to thirty-seven and a half tons, or one and a half tons per acre.

Pasture.—Five acres of ground are kept in pasture. The main part of the fodder for the cattle is from sowed corn, and other green crops, which are fed to them in the stable, and this pasture is used as much for the exercise of the animals as for the grass it produces.

Corn Fodder was grown on three acres of good ground, and a very heavy crop was obtained.

STOCK.

Cattle.—Thirteen cows are kept on the farm, several of them are full blooded Ayrshires, the rest being native cattle. A very fine Ayrshire bull is also with the herd. This animal took the State prize of $50, at the fair of the New Jersey State Agricultural Society, in September.

Two Ayrshire heifer calves, now coming two years old, and two yearling heifers of the belted Dutch stock, make up the horned cattle kept on the farm.

Swine.—Thirteen swine of the Jersey Red breed and three pigs, make up this stock of the farm. The breed proves to be healthy, easily kept, and readily fattened. They belong to the large breeds of swine, and can be kept entirely upon grass during all the Summer months. Thus far there has been a ready sale for all the pigs, as they are liked for breeding. It is proposed to keep a stock of these pigs to meet the demand for them.

Horses and Mules.—Three horses and a pair of mules are kept to do the work of the farm, and to take milk to customers in town.

EXPERIMENTS.

Experiments with different fertilizers on Indian corn, in 1878; size of the plots, one-tenth of an acre each. The results put down in the table are the rates per acre.

FERTILIZERS.	NUMBERS OF THE PLOTS, AND WEIGHTS PER ACRE IN POUNDS.									
	1	2	3	4	5	6	7	8	9	10
Sulphate of Ammonia	....	300	....	....	....	200	100	200	....	....
Superphosphate of Lime	....	....	500	....	....	300	500	300	500	....
Muriate of Potash	....	....	....	150	....	150	150	....	....	....
Potash Salts	....	....	....	....	....	....	....	150	....	....
Nitrate of Potash	....	....	....	....	....	....	....	....	175	....
Barnyard Manure	....	....	....	....	....	....	....	....	....	32000
Pounds of Corn	2450	1790	4120	4720	4010	4900	4810	4140	4540	4430
Bushels of 80 pounds	30.6	22.4	51.5	59 0	50.0	61.2	60.1	51.7	56.7	56.0
Cornstalks in pounds	1550	1150	2500	4200	2470	4150	3650	2900	3400	4350
Cost of the manure	0.00	$15 00	$8 00	$4 50	0.00	$19 50	$17 50	$4 50	$20 25	$24 00

The sulphate of ammonia used is the commercial article and contains twenty-five per cent. of ammonia. Muriate of potash is the common chemical fertilizer and contains 50 per cent. of potash. The superphosphate is Lister's standard bone superphosphate, and contains 13.82 per cent. of phosphoric acid, of which 6.91 is soluble, 4.09 reverted, and 2.82 insoluble. The potash salts are a by product of chemical works, and contain 45 per cent. of potash. The nitrate of potash is commercial saltpetre, and contains 45 per cent. of potash and 14 per cent. of nitrogen, which is equivalent to 17 per cent. of ammonia.

These experiments have now been carried on for seven years. They have been made upon a portion of the corn field each year and of course have all been upon different fields. It would be more satisfactory and instructive to have them made continuously upon the same plots from year to year, but there are no funds provided to meet the extra labor and expense which would be incurred in this way. As they are they furnish some points for comparison, which are presented in the following tables.

Experiments upon the growth of Indian corn on plots of ground, one unmanured, and the other manured with muriate of potash applied on the hills at the time of planting—

YEAR.	CORN.		STALKS.	
	NOTHING.	MURIATE OF POTASH.	NOTHING.	MURIATE OF POTASH.
	Pounds.	Pounds.	Pounds.	Pounds.
1872..................	5,505	5,532	6,000	7,104
1873..................	4,473	4,109	3,945	4,646
1874..................	3,840	4,563	3,312	3,787
1875..................	7,000	8,150	5,500	6,150
1876..................	2,050	1,950	2,950	2,950
1877..................	3,630	4,020	4,450	4,250
1878..................	4,010	4,720	2,470	4,200
Average.............	4,358	4,721	4,090	4,727

The amount of muriate of potash used was two hundred and fifty pounds per acre in 1872 and 1873; one hundred pounds per acre in 1874 and 1875, and one hundred and fifty pounds per acre in 1876, 1877 and 1878. Its price is a little under three cents a pound, so that the cost per acre on the ground has been near $5. The whole series of experiments shows an increase in the crop by the use of muriate of potash, but much more in the stalks than in the corn. The average of corn for the seven years being three hundred and sixty-three pounds, or 4.5 bushels an acre, and the stalks six hundred and thirty-seven pounds. The corn for seven years past has averaged about sixty-five cents a bushel, making the four and a half bushels worth $2.92, and the stalks, which would make twenty-five bundles, were worth at least $1 or $3.92, the value of the increased product. This is four-fifths of the value of the manure in a single crop, and as it is usually considered that not more than one-half of the fertilizer is exhausted in the first crop, it may fairly be inferred that muriate of potash can be used with profit upon Indian corn.

In the Agranomic Annals of France, there have been published within a year or two, the results of a series of experiments with potash manures on the growth of grapes and grape-vines. The following conclusions end the paper, viz.:

"1. The sulphate of potash and chloride of potassium have a marked efficacy upon the development of the vine, but nitrate of potash is superior to them, and carbonate of potash is inferior.

"2. Feeble vines appear to consume as much manure as vigorous vines do.

"3. Nitrogenous manures are more hurtful than useful.

"4. Potash should enter into the composition of manures for grape-vines, the elements in the soil being generally in bad con-

dition for assimilation; potash carries forward, in some way, with it, the other fertilizing principles.

"5. Potash from the root passes to the vine, to the leaves, then to the twigs to arrive at last at the fruit, of which it favors the development; its migration is comparable to those of the nitrogenized elements and phosphates.

"6. The potash introduced through the root in the course of a season, is not entirely consumed, since it is found after fructification, reserved in sufficient quantity, in the wood and in the twigs."

The conclusions here given may be suggestive to some of our cultivators of vines, and they have an interest in connection with our experiments on corn growing, in which the benefits of the potash manure are more seen in the stalks than in the grain, though it gives increased vigor to the whole plant. It will probably be found safest to compost the potash with barnyard, or peaty manure before applying it to the soil.

Experiments with sulphate of ammonia upon the growth of Indian corn, applied on the hills at the time of planting—

Year.	Corn.		Stalks.	
	Nothing.	Sulphate of Ammonia.	Nothing.	Sulphate of Ammonia.
	Pounds.	Pounds.	Pounds.	Pounds.
1872..................	5,505	5,918	6,000	4,638
1873..................	4,473	3,976	3,945	3,817
1875..................	7,000	7,100	5,500	5,500
1876..................	2,050	1,700	2,950	3,250
1877..................	3,630	5,650	4,450	4,000
1878..................	4,010	1,790	2,470	1,150
Average............	4,444	4,356	4,219	3,726

The results are almost uniform, in showing that this fertilizer does not increase the crop of corn at all, and it absolutely diminishes the weight of the stalks to a marked extent.

Experiments on the growth of Indian corn manured with superphosphate of lime—

Year.	Corn.		Stalks.	
	Nothing.	Superphosphate.	Nothing.	Superphosphate.
	Pounds.	Pounds.	Pounds.	Pounds.
1872	5,505	5,118	6,000	6,061
1876	2,050	1,950	2,950	3,050
1877	3,630	3,900	4,450	4,000
1878	4,010	4,120	2,470	2,500
Average	3,799	3,772	3,967	3,903

These experiments show that it has no marked effect on either corn or stalks.

Experiments on the growth of Indian corn with barnyard manure, applied on the plowed ground and worked in with the harrow—

Year.	Corn.		Stalks.	
	Nothing.	Barnyard Manure.	Nothing.	Barnyard Manure.
	Pounds.	Pounds.	Pounds.	Pounds.
1875	7,000	7,650	5,500	6,400
1876	2,050	2,200	2,950	3,000
1877	3,630	4,690	4,450	3,650
1878	4,010	4,480	2,470	4,350
Average	4,172	4,755	3,842	4,350

These results show that barnyard manure produces a marked effect on the growth of corn, invariably; not so great, however, in proportion to its cost, as at least one of the chemical manures. But it is probably more lasting.

The comparisons here made lead to the conclusion that barnyard manure and muriate of potash both have active and beneficial effects on Indian corn. And they suggest the inquiry whether a compost of the two would not be a specially good manure for this crop. It is hoped that an experiment to test this suggestion can be made next year.

The results also show the difficulty of making experiments which will be of practical value. The differences seen in the crops in different years are not owing to great differences in the

quality or richness of our soil, for it is pretty uniform. The rains at the proper time seem to have more influence than any other agent. The results with sulphate of ammonia subjected us to the ridicule of some old farmers the first year they were published, as showing a lack of skill or observation in making and recording the experiment. But the experiments of succeeding years have shown that the records were right, and that the substance used is a damage, notwithstanding it is of much value to some other crops.

During the past year, one meeting of the State Board of Agriculture has been held at the Farm, and the members went over and examined the establishment, its crops, stock and management.

A very satisfactory trial of ploughs has also been made on the Farm. This was under the management of the Middlesex County Farmers' Club and was very largely attended by representative farmers from the country around.

REPORT OF COMMITTEE APPOINTED TO TAKE CHARGE OF THE TRIAL OF PLOUGHS ON THE COLLEGE FARM.

Your Committee, appointed to examine and test the different plows present at a field trial, held on the College Farm, on the 18th and 25th days of October, report as follows:

At the first trial, after testing draught, depth, etc., of three ploughs, the weather becoming stormy the trial was adjourned for one week, when the following named ploughs were exhibited by the parties mentioned:

1, 2 and 3. Adamant B, L and A, by J. R. Brokaw, of Bound Brook.

4. Adamant A, with sulky attachment, by A. M. Plough Company of Chicago.

5. Carbon, No. 25, by Remington & Co., Ilion, New York.

6. Clipper, wooden beam, by A. Ten Eyck, New Brunswick.

7. Clipper, iron beam, by A. Ten Eyck, New Brunswick.

8. Syracuse, No. 3, by I. D. Bartley, of Cranbury.

9. Syracuse, No. 2, by I. D. Bartley, of Cranbury.

10. Wiard, "Union," by Bennett & Parks, of Jamesburg.

11. Wiard, "Junior," by Bennett & Parks, of Jamesburg.

12. Heckendorn, "Economical, No. 8," by S. & E. Hauck, of Mechanicsburg, Pa.

The following table gives details of the trial and results. Having prepared this table of results, your Committee consider their work done, without further particularizing or discussing the merits or demerits of the several ploughs competing, but in a general way recommend every plough as doing its work well,

and consider it a subject of congratulation to the farmers of the county that the ploughs of the earlier ages have been superseded by such excellent implements as were there exhibited and tested. Your Committee heartily thank Dr. Cook for his kindness in furnishing a field for the trial, and also Mr. West, of the College Farm, for many attentions and facilities afforded to the Committee and those who took part in the trial.

(Signed,) SAMUEL BLISH,
J. G. CORTELYOU,
A. N. CONOVER,
G. H. LAMBERT,
Committee.

NAMES AND DESCRIPTION OF PLOWS.—TEST OF OCT. 18TH. SOIL VERY HARD AND DRY.	Weight of plow in lbs.	Price plow complete.	Average depth of furrows in inches.	Average width of furrows in inches.	Area cross-section of furrow in sq. inches.	Av'ge draught in lbs.	No. of lbs. draught required to turn over a furrow with a cross-section of 100 sq. inc's.	Quality of work.	REMARKS.
Adamant B, wooden beam, straight coulter and wheel	100	$12.00	6.47	12.98	83.97	438.88	522.72	†.85	
Adamant B, wooden beam, with sulkey attachment	‖375	32.00	6.14	15.27	93.72	538.88	574.98	.75	Furrows rough and uneven.
Carbon, iron beam, with jointer plow and wheel	135	15.50	6.23	10.54	65.66	362.50	552.08	.80	The plowman did not do the plow justice.
Syracuse No. 3, iron beam, with jointer plow and wheel	125	16.00	6.55	13.06	85.52	424.50	496.37	.90	Soil very well pulverized.
Trial October 25th. Soil in excellent condition for Plowing.									
Adamant B, wooden beam, straight coulter and wheel	100	12.00	6.40	11.29	72.26	285.50	395.10	100	
Adamant L, wooden beam, straight coulter and wheel	125	14.00	6.12	12.96	79.38	356.25	449.18	.95	Well turned, but rather too deep for the plow.
Adamant A, wooden beam, straight coulter and wheel	100	15.00	6.69	12.56	83.99	428.12	509.73	.90	Well turned, but rather too deep for the plow.
Adamant A, with sulkey attachment	375	35.00	6.84	14.50	99.22	493.75	497.63	.95	
Carbon, No. 25, Remington & Co., iron beam, jointer plow and wheel	135	15.50	6.73	13.66	91.99	365.62	397.35	.95	Furrows not laid smoothly.
Ten Eyck's Clipper, wooden beam, straight coulter, no wheel	80	15.00	5.68	12.67	71.91	240.62	334.61	.85	Very uneven depth of furrow, and bottom of furrow ragged.
Ten Eyck's Clipper, iron beam, straight coulter, no wheel	93	18.00	5.61	11.96	67.10	250.00	372.59	.85	
Syracuse, No. 3, iron beam, straight coulter and wheel	125	16.00	5.48	12.71	69.65	287.50	412.77	......	
Syracuse, No. 3, iron beam, jointed plow and wheel	125	16.00	5.95	13.71	81.57	303.12	371.61	100	Well turned; needs but little harrowing.
Syracuse, No. 2, iron beam, jointed plow and wheel	140	16.00	6.36	15.04	95.65	409.37	428.00	100	Well turned; needs but little harrowing.
Wiard & Co.'s (chilled) "Union," wooden beam, jointed plow and wheel	125	12.50	5.59	14.71	82.17	290.62	353.69	.95	Plowman turned a wider furrow than the plow can turn well.
Wiard & Co.'s "Junior," iron beam, jointed plow and wheel	140	15.00	5.48	15.08	82.70	328.12	396.76	.95	
Heckendorn "Economical, No. 8," wooden beam, straight coulter, reversible point and wheel	180	15.00	6.43	12.92	83.07	362.50	436.38	.90	Bottom furrow smooth, good work for coulter plow.

‖ Weight of plow, 100 pounds; of sulkey, 125 pounds; of driver, 150 pounds. † 100 indicates the best work done in these trials.

There was also a trial of reapers, to test their capabilities of working in lodged grain, the trial being made upon our rye which was unusually heavy and very badly lodged. Some of the reapers were able to do such work remarkably well.

A great many visitors come to the farm to examine its working and to see the various crops, and the varieties of stock kept on it. It has some of the best kinds known, and it is unfortunate that there are not means to make the collection more complete, and to meet the expenses attending its exhibition.

DONATIONS.

From Messrs. Litser Brothrrs, of Newark, four tons of their standard superphosphate of lime.

From Messrs. P. Ballantine & Sons, of Newark, a car load of kiln dust, for top dressing meadows.

From Messrs. H. J. Baker & Brother, of 215 Pearl street, New York, one barrel of Forrester's cabbage fertilizer, and one barel of Forrester's potato fertilizer.

From John H. Knight, Esq., Monroe, Orange county, N. Y., two heifer calves of the Dutch belted stock of cattle.

The thanks of the Trustees of Rutgers College are hereby tendered to these liberal donors, who have so generously aided them in the important but expensive work they are carrying forward.

Agriculture in Europe.

REPORT ON AGRICULTURE AND AGRICULTURAL TEACHING IN EUROPE.

BY GEORGE H. COOK.

An appointment as a Commissioner to the Paris Exposition, without specific duties, has given opportunity to inquire into the present condition of improved agriculture and agricultural teaching, in some parts of Europe. Without pretending to completeness, the observations made may serve to give a distinct idea of the efforts now being made to increase the productiveness of agriculture, and to fit the coming generation of farmers for further and greater improvements in this oldest and most important of all arts.

Of the places visited and things seen were, the Bath and West of England Agricultural Society's Show at Oxford, June 13th and 14th; the international exhibition of live stock, held at the Paris Exposition June 15th and 17th; the International Agricultural Congress, held under the auspices of the Society of French Agriculturists, at Paris, and in excursions to noted farms; the Agricultural Experiment Station at Clermont; the Agricultural College and Experiment Station at Milan, Italy; the Agricultural Experiment Station at Munich, in Bavaria; the Agricultural College and Experiment Station at Weihenstephan, Bavaria; the Polytechnic School and School Farm at Zurich, Switzerland; the State Agricultural Institute Model Farm and Experiment Station at Gembloux, Belgium; the Campine sands of Belgium and Holland; the polders and the dairy cattle of Holland; the Farm School and Model Farm of Glasnevin, near Dublin, Ireland; and the farm of J. J. Mechi, Esq., at Tiptree Hall, near Kelvedon, Essex, England, about which so much has been written, were the chief.

No attempt will be made to narrate all that was seen at these different places, but some notes may be given upon such points as seemed to the writer of most importance to our people.

BATH AND WEST OF ENGLAND AGRICULTURAL SOCIETY'S SHOW, AT OXFORD.

The Bath and West of England Annual Show was held in Oxford this year. It opened on Monday and closed on Friday. It has the reputation of being the second of the great shows in Britain, the Royal Agricultural Society's being first. The weather was very wet and unfavorable, but the exhibition was remarkably fine. There were 816 entries of stock, and 4,200 of implements, and the attendance was very large. Thursday the grounds were thronged. The admission fee for Monday, Tuesday and Wednesday was a half crown (about sixty-two and one-half cents); Thursday and Friday a shilling (about twenty-five cents). The attendance at Bristol in 1874 was 110,000, and it ranges in different years from that down to 75,000 and 50,000, according to localities and weather.

The grounds occupied about forty acres, favorably located on gently sloping ground, about a mile and a half from the centre of the town, and easily reached by roads from every direction. The sheds were of very simple framework, roofed with canvas, and distributed over the ground so that the numerous visitors might have plenty of room, and be kept from crowding in any part. The entries for stock and implements were all closed the 17th of April, and those for poultry the 1st of May. This gave time to number and classify all the entries, to assign them places in the sheds, and to print very complete and easily understood catalogues of stock and of implements, and also one of the art exhibition, so that the visitor could find and examine the objects he was most interested in without any delay.

The implements were all under sheds, as indeed they must be in such rainy weather, and were of course easily reached on all sides. The cattle were tied in open sheds, so that they could be well seen; besides which a good deal of time was taken in parading them in classes, in the horse ring, so that the different animals competing for the same prizes could be compared. This ring was about three hundred feet long, and one hundred and forty or one hundred and fifty wide, so that one could see very plainly to all parts of it.

The Devon cattle were first in the list, but were not largely represented. They were very fine animals, but smaller than we are accustomed to see. The Sussex, another breed of red cattle, and placed much lower in the list, were more numerous, and the cows in particular were large and fine looking. They might easily be mistaken for Devons, and by our farmers would, I have no doubt, be preferred.

The Short-Horns were here, as everywhere else in England, in the largest number, and they were very fine animals, fatter than anything we are accustomed to see, and large—but not so

different from or so superior to ours as to need remark. Indeed we had on our steamer across the ocean, sixty-eight steers of this breed, from Illinois, that would need no apology in a show of this stock.

The Herefords were very large and fine animals, better I think than the Short-Horns, and the first prize for an animal of any breed was awarded to one of these. In early maturity they appear here to be quite equal to the Short-Horns.

The Jerseys, as with us, were in very large numbers, and in quality could not well be bettered. Most of the bulls were of one color, and the cows were nearly so too. Some of the exhibitions of the New York State Agricultural Society have shown a larger number of good cows of this breed than were here.

The Guernseys were represented by a few very choice animals from the Island of Guernsey and the south of England. This breed is frequently confounded with the Jerseys, but as shown here they appear to be quite easily distinguished. They are heavier, shorter legged, lack the fine eye and head of the Jerseys, and in color are yellowish red, generally with some large white spots. It is claimed for them that while their milk is quite as rich as that of the Jerseys, they give a much larger quantity. Some of the best butter makers in Chester county, Penn., believe this to be the fact, and there is a considerable sale for them now to go to the United States. The Rev. Joshua Rundle Watson, from Guernsey who took several prizes, had a number of animals on exhibition, which were handsomer specimens of the breed than any I had ever seen before. He had them ready for exhibition at the show in Paris, but when he learned that the show was to be on Sunday he withdrew them.

There were no Ayrshires or Holsteins on exhibition.

The sheep were shown under open sheds, in pens of low iron hurdles, so that they could be seen well from every side. The exhibit was a large and very fine one—two hundred and forty-two pens, of which forty-nine were South-Downs, forty-four Shropshires, thirty-one Oxfordshires, twenty-seven Hampshires, thirty Cotswolds, twenty-one Devon long wools, and nineteen Romney Marsh or Kent sheep. There were no Merinos or others of that grade. The South-Downs were very fine, as we are used to seeing them; but the large Oxfordshires and Shropshires were better and in much larger numbers than we ever have. So too, were the large but coarse Hampshires. These larger breeds are worthy of a more thorough trial than they have yet had in all parts of our country where there is a growing market for good mutton. It requires special skill to raise sheep and lambs profitably in our country, but I think if some of our most enterprising stock growers could see the fine sheep here, and learn to know the excellence of really good mutton, they would try harder than they have yet done to succeed in the

business which here is considered the best evidence of improved agriculture.

The horses were not shown in as large numbers as was expected. They were shown as horses for agricultural purposes, hunters, hacks and ponies. Those shown as hunters perhaps came nearer to the breed for all purposes which is best liked with us; but those for agricultural purposes were most surprising to strangers. They were enormously large and heavy, weighing, I should guess, from fourteen hundred to eighteen hundred pounds, and being almost, and in some cases quite full grown at two years old. It is a question which needs to be farther experimented on with us, as to whether these heavy creatures would not be more profitable for many farm uses than those we now employ. The ponies, too, seem to find work for which they are most profitable, and in the streets here, the variety in the sizes of the horses employed for different kinds of work is really comical.

The show of pigs was very good—fewer poor ones than are to be seen at our shows, though I think we have those as well adapted to our farming as any here. The Berkshires were in the greatest number, though the entries of the Large and Small White Breeds were numerous, and the animals good. The White Breeds were what we know as the Yorkshires. The Small Black Breed was well represented, and is much like what we know as the Essex—not superior certainly to some of our best specimens of that breed, but like them in being quiet, easy keepers and very fat. Except for their being rather shy breeders with us, I think them fully equal to any of the others. There were no animals like our more active, self-supporting Chester Whites, Magies, or Jersey Reds.

The show of poultry was large, and particularly in fowls was excellent and remarkable for the numerous breeds represented.

The show of implements was very large and complete. The steam-engines were perhaps the most conspicuous objects in the collection. There were ninety-four on exhibition—engines for plowing and cultivating, for driving threshing machines, for hay and straw-cutters, for mills, for breaking road material, and for all kinds of work where steam can possibly be substituted for manual labor or horse-power. They were in motion, and made a very attractive part of the exhibition. And the steam-engine holds a much more important place in the estimation of farmers in England than it does with us. Steam plowing is extending every year; the engines not being bought so much by farmers as by engineers and machinists, who then take jobs of farmers for plowing or cultivating by the acre, and in this way one engine is used for many farms. They are especially sought for where deeper plowing or grubbing is desired. The implement called a grubber is like one of our corn cultivators with harrow

teeth, only it is very large and strong, and the teeth can penetrate and tear up the ground to a depth of from twelve to eighteen inches, or even more. Such work is very desirable in some cases, and it is entirely beyond the power of horses to do it. The engines for steam culture range from eight to fifteen horse-power, but some have been built of thirty horse-power. The harvesters and reapers were in large numbers, and our own were well represented; and in the harvesting which was done in a field of green rye, McCormick's harvester and binder took the preference. I believe there were no prizes for implements.

The plows, harrows, horse-hoes, drills, &c., were so different from ours in form and weight that it is difficult to make a proper comparison. They are heavier and larger. In most cases, I am sure our people would prefer our own; but when the superior work done by them is seen, it leads to the question whether this is due to the implements or to the greater skill of those whose whole time is given to plowing, or some other single branch of farm work. It is very certain that in evenness, fineness and smoothness of surface, in straight and uniform rows of drilled and hoed crops, the average work here is much better than with us.

There was no exhibition of farm products, except what was shown in the sheds of the great seedsmen, Carter & Sutton. They showed mangold wurzels of last year's growth, and they had fine exhibits of all the seeds they sell. They were particularly strong in their exhibits of grass seeds, of which the English farmers use a much greater variety than with us. They showed the seeds, the grass growing in pots, and full-grown dried specimens. The show was well worth studying, and when one sees the thick mat of grass in the English pastures, and the heavy swaths which are rolled up in their meadows when mowed, it suggests the inquiry whether we have not something to learn in this respect from them. A succession of grasses from the earliest to the latest in the season is desirable, in pastures, and it can be got by a mixture of different varieties of seeds, though it is probable our hot and dry Summers would show that many of the English grasses are not adapted to our climate, but the proper ones could be found. Different soils are not equally well suited to all kinds of grasses, and Carter has for years had in his catalogue lists of the seed mixtures adapted to lawns, meadows and pastures on the soils of the different geological formations of England. And Sutton had a large geological map of England, to show the location of the various soils, and his catalogue was accompanied by a smaller geological map of England, and with lists of the seeds which grow best on the different classes of soils. This is a subject which has received very little attention in our country, but which is obviously of much importance. Every-one sees this in regard to the natural growth of woods on differ-

ent soils, and it is equally plain in regard to the difference in the growth of crops on sandy, clayey and limestone soils.

The horticultural show was not very large, but it was remarkably rich in its specimens of orchids, ferns, and rare and beautiful greenhouse plants.

There was a large show of commercial fertilizers from two or three manufacturers, and each was accompanied by a guaranteed analysis. The fertilizers were in great variety as to richness and the proportions of ammonia, phosphoric acid and potash in them, so as to meet the requirements of any soil or crop. The English use much larger quantities of chemical manures than we do, and, though still subject to frauds in quality in some instances, the respectable dealers in them, and the intelligent farmers who use them, are coming to fully understand the meaning and value of a good analysis.

The weather was not favorable for the show, as it rained every day. The attendance probably did not reach above fifty thousand.

The Society is in its one hundred and first year. It has more than one thousand members, an annual income of from $50,000 to $60,000, and it paid out in premiums last year on—

Cattle	$3,700
Sheep	2,140
Pigs	600
Horses	2,125
Poultry	705
Special on stock	1,540
	$10,810

THE SHOW OF LIVE STOCK AT THE PARIS EXPOSITION.

This show was held in the esplanade of the Hotel des Invalides, where commodious sheds and enclosures were provided for the cattle, &c. The entries were—

Cattle	1,700	Geese	50
Sheep	825	Ducks	134
Swine	381	Guinea fowls	18
Goats	5	Pigeons	419
Fowls	1,461	Rabbits	394
Turkeys	92		

The entries were carefully classified and numbered, and the animals were arranged in their proper sheds, and the catalogue was printed with references and numbers, so that every individual could be found without unnecessary search or delay.

This show was a most interesting and instructive one, but details in regard to it would be out of place here. Of the cattle, the Shorthorns were among the most admired; but there were

fine cattle from the various countries of Europe. The white Charolaise oxen of France presented a fine appearance; the brindled cattle of Normandy were also very large, heavy, and good-looking. The cows of the Holland breed—large black and white cattle—were, after trial, pronounced the best for milk of any of the breeds shown. Very few of the Channel Island cattle were on exhibition. Except in the Holland cattle, there was nothing better than the best shown at our fairs.

The sheep were more numerous and of better quality, both for mutton and wool, than we are accustomed to see, though some specimens of the Merinos, the Southdowns, the Leicesters and the Cotswolds are seen with us which come very near to the best of these. The English sheep made the best show of any there. A few Irish Roscommon sheep were on exhibition, which might perhaps be worthy of introduction among us. They are very large white sheep, with coarse, long wool. They are represented to be very hardy, and capable of keeping themselves in good condition with coarse fare and exposed to bad weather. They generally have twin lambs, and give milk enough to fatten both. This breed was afterwards seen in Dublin market, large and fine animals. If they should prove as well adapted to our climate as to the cool and wet one of Ireland, they would be an improvement on our present races.

The swine from France and other parts of Continental Europe were much more slender and lighter built than ours. The English Yorkshire and Berkshire breeds were the best seen, though there were a few good specimens of the Essex breed.

The specimens from the poultry yard were very numerous, and some of great excellence. To one accustomed to discriminate among the different breeds of domestic animals, such an exhibition must be very profitable: for it costs no more to keep good animals than poor ones, and when the best are known it becomes possible to have them in place of the poor ones.

The exhibition of horses was not held till September.

INTERNATIONAL AGRICULTURAL CONGRESS.

The International Agricultural Congress was held at Paris, from the 11th to the 20th of June, and with excursions following to the 24th. There were some four hundred persons present,—most of them French, of course--but there were representatives from all the countries of Europe, from the United States and from South America. It was held under the auspices of the *Societe des Agriculteurs de France* (French Board of Agriculture), of which M. Drouyn de L'huys, Minister of Agriculture and Commerce, is honorary president, and M. Le Marquis de Dampierre is President. The Society has nearly four thousand members, and is well represented from all parts of the Re-

public. The morning meetings were in sections, of which the Society has eleven. These were held in the Tuilleries, beginning at eight and a half A. M. The afternoon meetings were in general sessions, and were held at two P. M., in the new building on the Trocadero.

There were numerous topics presented for discussion, such as epizootics, and international measures to counteract them; re-foresting, and its influence on inundations; foreign legislation upon alcohol; utilization of sewage water; French agricultural experiment stations; the ensilage of maize; reports on the agriculture of Belgium, Italy, Hungary, Russia, England, Scotland, Ireland, &c. But the subject which evidently attracted the most attention was the phylloxera, the damage it is doing to the vines, and the means of overcoming it. A gentleman from Marseilles said it had destroyed one million two hundred and fifty thousand acres of vineyard, which were worth $800 per acre—($1,000,000,000)—which is about one-quarter of all the French vineyards, and it may well be looked upon as a question of the greatest importance. The discussion upon it appeared very animated, so much so that one lady made a very earnest address in regard to it. The opinion was general that it had come from America. While many processes were proposed for destroying the phylloxera, the most common view was that the hardy American vines could withstand its attacks, and they should be introduced, and the French grapes grafted on them.

EXCURSIONS.

To the Farm and Works of M. Decouville.

Under the auspices of the Society several excursions to interesting agricultural exhibits were made. One, on the 14th of June, was to the establishment of M. Decouville, adjoining Petit-Bourg, the old chateau of Madame Montespan, on the west bank of the Seine, seventeen miles south of Paris. M. Decouville, belongs to an old French family which has been here for centuries, and which has considered it unworthy of the family to follow any other occupation than that of agriculture, and one which also understood that, to be a good agriculturist, one could not know too much. The father of the present owner graduated in a law school, about 1845. The estate then covered about six hundred acres of land, but he immediately began to lease adjoining properties, until he had control of fifteen hundred or sixteen hundred acres. His first farming was in the ordinary cultivation of grain for market, but in 1854 he began the cultivation of beets for making alcohol, a business which is still a leading one on the farm. In planning for the apparatus for extracting the juice from beets and distilling it, he found the esti-

mates of cost so high, that it would be profitable to get workmen and make it at home. He did so, and started a business which was successful, and is still continued, and furnishes distillery apparatus to distillers in all the country around, keeping seventy workmen employed. The farm is situated on the high and level plain through which the Seine has cut its way, and is a mellow, sandy loam, which, by good cultivation, is now in the highest state of fertility. It is underlaid by a cellular, quartzose rock, called here *meuliere*, and which we know as French buhr millstone. At Petit-Bourg the rock is not solid enough for millstones, but it is good enough for the foundations of buildings and for road material, and being directly on the bank of the Seine, which is here navigable, it can be quarried and delivered in Paris at low prices. This business has been developed by M. Decouville, and he is now sending annually to Paris forty thousand cubic yards of building stone, and six thousand five hundred yards of broken stone for roads, from which he receives a gross sum of about $70,000.

Necessity for sufficient and economical transportation for this large quantity of stone, and the still more urgent need for the immediate movement of the beet crop, which amounts to about 10,000 tons a year, led Mr. D. to devise a substitute for the horses and oxen which had heretofore done all the farm work. He perfected a system of portable iron railroad, in which the complete track, with cross connections and locks for joining the several lengths, which are each about a rod long, weighs only 103 pounds, and can be easily handled by one man. This railway can be laid down anywhere on the surface of the ground, and used without any preparation of the surface. The tracks are from fourteen to twenty inches apart, according to their uses. They cost about $1,600 per mile. Their success has been remarkably great, and they are used not only on farms, but in manufacturing establishments, in coal mines and in iron mines, and they are finding new uses every day. He has sold some three hundred sets of them in France. Cars of different forms, according to the uses required, are made for them, and little locomotives are used, or horses, as may be found best. I saw a train of ten cars, each loaded with a ton of stone, drawn by one horse—though the usual load was five tons. The track was also laid down across a freshly plowed field, and cars loaded with manure were drawn over it. This work can be done when the ground is too wet and soft to be traversed by teams and loaded wagons.

The farm is cultivated by steam, and three sets of Fowler's engines, with proper plows, grubbers, harrows and rollers, are in use. An exhibition of these was made on the land, and this was really an important part of the visit. The work was admirably

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done, and so rapidly that no set of teams could possibly do it in the same time.*

The farming is very simple. The land is all arable, cultivated in a three years' rotation of beets, wheat, rye and oats, and then beets again, and so on. There are some small fields of beans, lucerne, and some other minor crops for farm use, and the culture of hops is being tried now. But the main plan of the farming is to get the largest return possible by the use of large capital and heavy manuring. He keeps as large a stock of fattening cattle and sheep as is needed to consume the pulp of the beets, and he keeps also a few cows for milk. He sells alcohol, beef, mutton. wheat, rye and rye straw. He buys lean cattle and sheep, manures, and as much as he needs of oats and lucerne. All the manure made on the farm is used on the beet ground, and about $48 worth of chemical manures per acre additional. For the wheat which follows the beets he uses only chemical manures, $8 worth per acre. On the oats and rye no manure is used. The crop of beets was very promising. The plants are all cultivated on the flat system—in rows about twenty inches apart, and the plants about ten inches apart in the row. The work of cultivation is done largely by horse hoes, and the ground is so rich that the plants soon outgrow the weeds. The crop averages about twenty-five tons per acre.

The wheat, rye and oat crops were very large and heavy, better than we often see with us, but I could not learn the average yield. The crops were not quite ready for harvest on the 21st, but the wheat and rye would be ready in about a week. It was well filled, but very badly lodged. It was to be cut by hand, using large sickles. There are some curious and interesting relations between Mr. D. and his workmen, in which he takes much care to promote their interests. There is one of the largest manufactories of straw paper in France near the farm, and an important product of the farm has been the rye straw for paper, but the price has now fallen so low that it scarcely pays. The distillery was not in operation, and was not shown. The beet harvest begins about the 15th of September, and the beets are all worked up by the end of January. The profit on alcohol is said not to be large, and Mr. D. is experimenting on the growth of hops, so that if successful he can help to supply the wants of the breweries about Paris. The consumption of beer is rapidly increasing in France.

As a specimen of what the French call intensive farming, the practice of M. Decouville is one of the most interesting in the country. He has received the highest awards from the agricul-

*The extension of steam culture in different countries is interesting. The agent of John Fowler & Co., who was present, told me that they have 1 200 of their machines in use in Great Britain and Ireland, 14 in France, 104 in Germany, 25 in Austria, 12 in Russia, 250 in Egypt, 70 in West Indes, 12 in Peru, 7 in Italy, 6 in Spain, 10 in Australia, 11 in East Indes, 2 in California, and 3 in Louisiana. There are some other steam cultivators made by Howard and other makers, used in Great Britain, but not many in other countries.

tural societies, and the place is visited by students, and by farmers, to see and profit by his example. I was sorry not to get more definite information about the products of the farm and their yearly value. But it is plain to any observer that the business is prosperous, and it is conducted in the most intelligent and systematic way. The company on the trip numbered more than one hundred, and we were entertained with a collation, and short, complimentary speeches were made by several of the farmers from other countries of Europe.

The Sewage of Paris.

The 24th of June was given to an excursion to Gennevilliers, where the sewage water of Paris is used to irrigate and enrich market garden land. The questions of sewage, its removal and purification for sanitary benefits, and its uses for agricultural purposes, have been discussed in Paris much as in other cities. Friends of sanitary improvement, however, have insisted that the first step should be taken, and the first expenses incurred in the interests of public health, and in spite of determined opposition have carried their point. A very successful beginning has been made.

In most of the houses in Paris there are two sets of drain pipes. One of these connects the washing sinks, bath-tubs, etc., with the city sewers. The other connects the water-closets with cess-pools in the house yards—and these last are pumped out and the contents are carried off to be used on the land. It is only the sewage from the former kind that have to be attended to, and for this purpose the whole contents of the public sewers are collected in very large conduits, from both sides of the Seine, and are conducted down to Asnieres on the river, and just at the outskirts of the city. Here, by means of powerful pumps, about one-third of all the sewage water is raised high enough to flow by gravity over a large tract of flat land in the bend of the river just below this place. The rest of the sewage is allowed to enter the river here. The amount of sewage carried in the sewers yearly is about one hundred and thirty-three million cubic yards, and—as a cubic yard is not far from two hundred gallons—the daily flow of sewage is about seventy-three million gallons. One-third of this, or twenty-four millions, is daily pumped up twenty or thirty feet to distribute it over the peninsula on which Gennevilliers stands, comprising about one thousand acres.

The sewage is carried to various parts of this plot in closed pipes, and is then let out into open ditches, which are a little above the general surface of the ground. From these it is let out into little irrigating ditches, which are drawn parallel to each other and about three feet apart, so that the whole ground looks as if laid out into garden beds. The beds are planted, and

water in the little ditches soaks through and moistens and feeds the roots of the growing plants without defiling or in any way injuring their leaves or stems, and a most luxuriant growth is produced. Every year the little ditches are changed, and where those of one year are, is the middle of the bed the next year, and the sediment of the ditches is scraped out to mix with the soil as manure. In Winter the water can be distributed over the whole surface, but in Summer, when the vegetation is active, it needs skill and experience to put on the water or withhold it at proper times. The gardeners, however, have learned to do it successfully—and the land which nine years ago was only an open gravelly sand, so poor that but moderate crops of rye could be grown on it, is now the most productive garden soil about Paris. When the experiment was begun no one would take the water, and the city bought about twenty-five acres of ground on which to make the first trial. That land is now rich, and rents yearly for $40 an acre, and the adjoining land-owners, who have concluded to try the effect of the water, have increased their rents four fold—the average rent being now about $36 an acre. No one who has taken the water has yet discontinued its use.

The first effect sought—that of purifying the water—is produced completely. As it comes from the sewers it is dark colored, turbid and of a vile odor. After being filtered through the cultivated ground it collects in the underdrains and runs out clear, cool, without smell or taste, and to chemical tests shows no organic matter. In fact, the little brook we saw looked like the purest and most tempting of spring waters, and those who drank it said it was so.

The crops grown on this soil are cabbages, beets, carrots, beans, artichokes, cauliflowers, garlic, onions, leeks, celery, salsify, pumpkins, potatoes, mint, absinthe, angelica, and nursery and fruit trees.

A committee of investigation who examined this subject in all its relations, reported the following as crops per acre raised on those grounds;

Artichokes—From 14,000 to 30,000 heads.

Cauliflowers—12,000 to 20,000 heads, weighing from 30,000 to 35,000 pounds.

Garlic—32,000 pounds.

Carrots—52,000 to 72,000 and even 115,000 pounds.

Celery—87,000 pounds.

Cabbage—120,000 pounds.

Onions—From 52,000 to 72,000 pounds.

Leeks—52,000 pounds.

Potatoes—From 25,000 to 35,000 pounds.

Pumpkins—100,000 to 120,000.

Salsify—8,000 to 10,000 bunches, weighing 22,000 pounds.

A remarkably fine dairy is kept there, and the cattle are fed on lucerne grown with sewage, and we were treated to strawberries grown on ground irrigated with sewage water, which were as large and unexceptionable in flavor as Durand's "Great American." The vegetables are among the finest looking in market, and are unquestioned in flavor and good quality. The commission reported that "the quality of the products, which had been condemned by some persons, was now acknowledged good; they retain the flavor which properly belongs to them, and do not contract any bad taste."

The benefits of this use of sewage water, both for its sanitary and agricultural effects are fully demonstrated, and proves the soundness of the views of those who devised and carried it out. So far, the whole expense has been borne by the city. No charge has been made for the supply ditches and drains, or for the water. At the present time the question is being raised, whether the land-owners, whose rents have been increased, and the gardeners, whose crops have been so much enlarged, should not pay a part of the expense. It is, however, generally conceded that the main part of the expense must be paid for the public good, and for the benefits which it brings to health, and that it cannot be expected that sewage water, diluted as it is, can ever be used on agricultural land so as to pay the whole cost of distributing it.

The present effort is very encouraging to sanitarians, and has only been reached after a great deal of talk and unsuccessful work for the same end. On the ground where the sewage is now distributed, we saw large reservoirs into which the sewage water was formerly drawn in order to precipitate the fertilizing matters by some chemical process, but it failed. The water was made clear but the main impurities were not removed, and the works stand there as a monument of the work required to accomplish this end, so important for all cities where filth will accumulate and must be removed or destroyed.

Excursion to a Beet Sugar Establishment.

One of the most instructive excursions made by the members of the Agricultural Congress at Paris, was to the farm of Mr. G. Decrombeque on the 22d of June. This farm is at Lens, about one hundred and twenty miles north of Paris, nearly sixty miles from Calais, and not far from the Belgian boundary. There is a small coal basin there, and the soil is derived from rocks of the coal formation, and is clayey, cold and poor. The father of Mr. Decrombeque, however, began improvements here many years ago, and was among the foremost of those engaged in making beet sugar, and at his death requested his son to continue the work he had begun, and thus honor his father's enterprise. This

has been done most successfully, and the farm is now known as one of the best managed in all France, and it received the highest award of honor in the report of the French Board of Agriculture in 1876. The distance from Paris was so great that only twenty-five or thirty persons went out to visit the farm, but these were treated with the greatest attention by Mr. D. They were his guests at Arras, and at Lens he took them in carriages over all parts of his farm, showed his crops of beets, wheat, oats, rye barley and lucerne, his methods of tillage and fertilizing, his machinery for sugar-making, his pits for preserving the pulp of beets for fodder, his stables for fattening bullocks, his arrangements for keeping horses and preparing fodder and feed for stock, and his methods of preparing artificial manures. He also showed his office and the systematic and full records which are kept of all the expenses of the establishment, and which are submitted to him daily.

After going over all these and giving full opportunity for examination and questions, and also showing the former condition of land by the present state of some of his neighbors' adjoining, he ended the day with a grand dinner. This was as well received as the instruction had been. And both were so well done that one could not doubt his ability or his fairness in this public exhibition of his agricultural labors, and their success. At the close he distributed among us printed copies of the statistics of his establishment. From this I translate some parts and compute the French weights and measures into the corresponding American ones. It will be observed that these are in round numbers, but he gave them in that way.

The farm at Lens contains six hundred and eighty-seven acres, and it fattens annually on an average four hundred beeves, which are worth $68,000; produces nine thousand six hundred and twenty-five bushels of wheat, six thousand six hundred tons of sugar beets, six thousand eight hundred and seventy-five bushels of oats, besides the hay and other feed.

The crops of 1877 were as follows: Red Kissingland wheat, with white straw, two hundred and seventy-five acres, yielding forty-four bushels per acre; Prince Albert wheat, seventy-five acres, yielding forty-six bushels per acre.

White Salins oats, one hundred and twenty-five acres, yielding eighty-two bushels per acre.

Winter barley, twenty-five acres, yielding sixty-six bushels per acre.

Sugar beets, three hundred acres, yielding twenty-four tons per acre, and producing in the factory seven and one-fourth per cent. of sugar, or three thousand four hundred and eighty pounds of sugar per acre.

He says: I produce annually on the farm at Lens three thousand five hundred and twenty tons of barnyard manure, which

remains in the litter under the cattle permanently until loaded into the cars, to be removed directly to the fields.

Additional manures are also employed in large quantity. I use Indian colza cake on winter grains, and sesame cake on my spring crops; for me these are complete manures.

I find great profit in using mineral manures. I use nitrate of soda, nitrate of potash, sulphate of ammonia, and superphosphate of lime, in proportions varying with the richness and composition of the soil.

The high prices of fertilizers, and the little confidence in the composition or purity of those in commerce, have led me to make my artificial manures on the farm. I manufacture superphosphate of lime, sulphate of ammonia, and nitrogenized manures; superphosphate of lime from the waste bone black, which has been used in clarifying sugar, by treating it with sulphuric acid; sulphate of ammonia, from the gas works of my establishment, and from some others which were formerly wasted and are now collected by me. This manufacture is very simple and inexpensive.

The organic manures which I manufacture are from the blood from the slaughter-houses of Lens, which I dry by the well-known methods.

I am also the purchaser of the waste of meats, muscles, skin, intestines, unsalable flesh, &c., all of which I treat with sulphuric acid, and afterwards solidify by adding waste bone black, which neutralizes the excess of sulphuric acid and forms superphosphate of lime. I have thus a mixture of animalized superphosphate.

The buildings and apparatus for preparing the manures have cost me about $600. I shall produce this year, fifty-five tons of superphosphate, twenty-seven and a half tons of dried blood, and twenty-two tons of animalized superphosphate; all that is needed for my crops. I think that large farmers from seeing my arrangements for manufacturing manures, and the advantages which may be drawn from it, will do as I have done, and not let the valuable fertilizers from the gas works and the slaughter-houses run to waste.

I produce nitrate of potash by concentrating water coming from the sugar factory, and the molasses, which are charged with all the soda and potash of the beet juice. These I concentrate and put into my fertilizers. They amount yearly to twenty thousand or twenty-two thousand pounds.

The cultivation of beets is upon low ridges, for which I use Howard's ridge plow, Crosskill's roller, Herrisson's roller, a special drill for ridges, an articulated roller of cast-iron, a special cultivator, and an Eveloy's weeder. The cereals are cultivated on the flat, and I use James Smyth's sower. I use two horse-hoes of Priest & Woolnough, Howard's harrow, and his chain har-

row. I use Wood's mower and Samuelson's harvesters. The threshing machinery is after my own patterns, with Garret's thresher, and made by Albarct. This thresher is so well arranged that the whole expense for power and labor is less than three eents a bushel.

The deep plowing on the farm is done with Wallerand's large, invertible double-plow; ordinary plowing is done with the eommon invertible double-plow. Light plowing is also done with a gang-plow of three mouldboards, which saves a plowman and a horse on two eommon plows. Coleman's and Howard's best harrows and cultivators are used. Manures, both dry and semi-fluid, are applied by Smyth's broadeast distributor.

My stables will hold one hundred and eighty bullocks, each of which shelters twenty-eight in two ranks. They are very spacious, so that eaeh animal has nine hundred cubic feet of air, and they have been so economically constructed that the first net cost of providing shelter for one animal was only $30; and this eost includes gas pipes for lighting, pipes and troughs for the water supply, and a little railway for bringing feed and carrying out the manure.

I have also a stable intended to eontain thirty cattle, which is separate from the other parts of the establishment, where I put the cattle newly purchased until I am assured that they are not diseased in any way, and I thus avoid the dangers of contagion. I have stables for forty horses, constructed on the best hygenic principles, with all conveniences for ventilation and economy.

Two steam-engines are employed. One threshes, grinds oil-cake, drives a pair of millstones and a large straw-cutter; the other puts the screen in motion, eracks grain for feed, and drives the pump which raises water for all the uses of the establishment. The granaries, the mixing of rations for horses and cattle, and the weighing of ingredients for the fertilizers, are in another building.

The feed of the horses and cattle varies with the season and the prices of different kinds of feed. A considerable quantity of oil-cake is fed to the fa tening cattle, and the food of both is sprinkled with water containing a little salt.

The sugar-house is eonstructed to work up about one hundred and ninety-two tons of beets daily, and is supplied with the most approved machinery to diminish hand labor, and to produce the most sugar, and that of the best quality. The yearly product of sugar is from eight hundred and eighty to nine hundred and ninety tons, of which two-thirds is crytalized white sugar.

A laboratory is arranged in the works, for the analysis of beets and determination of sugar. It is useful also in analyzing manures and guiding in their eomposition.

The system of accounts is very full, as well as very praetical.

An account is opened with each animal, and is continued until he is sold. The accounts for manure and for hand labor are equally full, and all are submitted daily.

In conclusion, I only signalize the improvements I have made, to show those who are in the condition in which I found myself when I began, so that they may come to see my farm, where they will find the results of labor, guided by science.

The day spent at M Decrombeque's was a very profitable as well as a very long one. We did not get back to Paris till midnight. But the day was well spent, and no one could go about the farm there without acknowledging that the same spirit of agricultural improvement which we see at home is equally active among the French farmers.

AGRICULTURAL EDUCATION AND AGRICULTURAL EXPERIMENT STATIONS IN FRANCE.

The agricultural school at Grignon, was founded in 1826, and is still continued. Several agricultural experiment stations are in operation and have been for several years, and last year the government organized the *National Agricultural Institute* at Paris, with M. Eugene Tisserand as director and with a corps of teachers, including some of the most eminent scientific men of the country. Its object is to favor agricultural progress, and to raise the level of the science in its relations with all branches of animal and vegetable productions by educating:

1. Agriculturists and proprietors possessing the scientific knowledge necessary for the best cultivation of the soil;
2. Capable and instructed administrators for the different public or private services in which agricultural interests are involved;
3. Special professors for agricultural teaching and for directors of agricultural experiment stations.

The Institute is composed of—1st. The school of high agricultural studies established in the buildings of the Conservatory of Arts and Trades, in Paris, and—2d. Of a complete establishment for experimentations and researches to be carried on at the farm at Vincennes.

The first report of the Institute is just published, and the following material is taken from it:

The Institute was opened December, 1876, with thirty-two applicants for admission, of whom twenty-six were passed; of these, six were foreigners. At the opening in December, 1877, there were thirty-three new applicants, of whom twenty-seven passed; of these, seven were foreigners. There are now in the two classes fifty-three students who are candidates for degrees. Besides these, ninety-six persons have attended the lectures of the professors without undergoing examinations or being candi-

dates for degrees. The course of instruction is full on all the sciences which find application in any branch of agriculture,—is made practical in laboratories and museums,—and is illustrated by excursions to farms, dairies, drainage works, distilleries, breweries, manure factories and botanical grounds, where descriptive notes are taken for the study and preparation of papers to be submitted to the professors. The examinations are strict and thorough. At the end of the first year, the Director reports that "the conduct of the students has been orderly; their deference to their teachers praiseworthy; absences and tardiness rare; some reprimands have been administered by the Director for light faults, but no punishment has been ordered by the Council during the first year; the examinations, both special and general, have resulted satisfactorily, and all the students have been passed."

At the entrance examination, for the benefit of those who show high attainments in scholarship, there are four purses of $200 each, and five of $100 each, with free tuition in both cases, and ten scholarships free of tuition fees. Three of the first, one of the second, and four of the third were awarded at the first examination. At the second admission there were awarded four of the highest, one of the middle and six of the lowest.

The Director says, "it is evidently not to learn how to plough or to harrow, to harness horses or oxen, or to groom animals, that our best agriculturists send their sons to the Agronomic Institute. They well know that practice must be acquired in the fields, by taking part in all labors which fit the workman for his work; they know that they can themselves give this instruction better than others, and that there are thousands of farms in France where an apprenticeship to farming can be served. They justly ascribe a higher office to the Agronomic Institute. They ask that their children may be taught what can only be learned from the instructions of, and contact with, the distinguished men charged with this teaching—that is, the principles of science, and with these principles, scientific practice. As to the simple practice of agriculture, which ought, in its turn to fructify the truths of science, they will know how to furnish it to these same young men when the latter have quitted the halls and laboratories of the Agronomic Institute."

In regard to the establishment of the Institute M. le Marquis de Dampierre, one of the members of the National Assembly, appointed to prepare the report upon the need of its organization, says:

"Astonishment is sometimes expressed that the friends of Agriculture demand for agricultural instruction the aid of the State, and the objectors say that agriculture is an industry like all others, and ought, like the others, to sustain itself by its own

efforts; to live and make progress by its own resources. This objection involves a grave error which should be corrected. Agriculture is not only the most difficult of industries, it is also the most necessary. It is the nursing mother of the country; so much so that on its prosperity or decline depends the prosperity or decadence of France. In all other industries, properly so called, man is the master of the forces which he has to combine to arrive at the sought-for, at the desired result. Plans and calculations are required; his genius applies itself to them and he succeeds. In agriculture, on the contrary, it is God alone who disposes of the most powerful elements of production, and the work of man is confined to utilizing what he learns to know of the natural influences of the soil and atmosphere—in seeking means to neutralize the effects of atmospheric, pestilential and insect agencies which he cannot arrest. While certain rules and fixed laws are the infallible guides of the weaver, the metallurgist, the distiller, sugar maker and the refiner, agricultural science and practice is in constant struggle with that of which they are uncertain; and so are, without doubt, in a condition of inferiority with respect to other branches of industry."

The farm school at Grignon has a settled course of instruction in scientific and practical studies relating to agriculture, and a farm of nearly three hundred acres, under good cultivation, is used for practical illustration of everything relating to farm management. The course of instruction covers three years. There are from eighty to one hundred students, mostly sons of farmers, who expect to take the places of their fathers, or to rent or buy other farms. The graduates of the school have given character to French farming, and many of them now occupy prominent places where agricultural interests are in any way involved.

The Agricultural Experiment Station of the East, located at Nancy, is under the direction of Prof. L. Grandeau. It has been in operation ten years, and many and most valuable researches have been carried through and published, to the great benefit of progressive farmers. Mr. Grandeau has just printed a report on the applications of Chemistry and Physiology to the culture of trees, in which he has embodied his researches for the last ten years upon that subject. No better specimen of the practical usefulness of experiment stations can be given than is to be found in the "Conclusions" with which he ends his research on the "Use of the organic matters of the soil in the nutrition of plants."

These conclusions are—

"1. The mineral theory of the nutrition of plants as developed

by its illustrious author. Justus Liebig, is absolutely true. All the food of plants belongs to the inorganic world.

"2. The black substance of dung and of humus is not absorbed to any extent by plants.

"3. The doctrine of humus, false in the interpretation which has been given it by its partisans, accords perfectly with the mineral theory when the facts shown in this paper are fairly considered. The alliance of the two doctrines in the limits traced explains in a rational manner the connected action of organic matters and the mineral principles of soils.

"4. The exclusive doctrine, called that of chemical manures, is not tenable in presence of facts which have been cited. Applicable to some particular cases, it cannot be followed by the generality of farmers without leading to the ruin of those who practice it to the letter.

"5. Whatever George Ville may say, meadows and cattle are not heresies. If so, thank God French farming is still in the intelligent hands of the heresiarchs. It is now more than ever necessary to increase the production of barnyard manure, and to improve the preservation and use of this important substance. It is more needful to manure meadows than any other cultivated fields; the latter, in consequence of their richness in organic matter, are fitted to receive mineral manures usefully.

"6. The astonishing fertility of certain unmanured cultivated soils and the indefinite fertility of forests, both receive a rational explanation, and one conformed to known facts. It is necessary to guard against the destruction of forests, which, besides the advantages they give by producing in trees crops of great value, furnish, for the most part, soils of only moderate quality.

"7. It seems possible to ameliorate soils, even those which are uncultivated and sterile, by incorporating in them organic matters fitted to render the mineral elements of the soil assimilable, provided the organic matters can be obtained.

"8. In order fully to develop the fertility of soils it is necessary to proportion the combined mineral matters to the organic substances. Better than any other method of examination, the analytic process will show the actual fertility of a soil. Combined with the proportion of the principal mineral substances this indication will furnish the important elements for estimates to the cultivator.

"In agriculture as in everything else, absolute doctrines are unfortunate; however specious the arguments to defend them may be, however plausible and positive their advocates may appear, they must be distrusted, especially if they lead to the contradiction of facts which have been settled by the experience of ages. * * * * * To work, to observe, to compare and experiment, without fixed opinions and with

the single object of discovering a portion of truth, is the only sure way."

Professor Grandeau has devoted a great deal of time and labor to the study of this subject, and has learned to put a very high value upon the black matter of soils and manures as an absorbent and as a solvent of the mineral elements of the soil and of mineral manures. And the conclusions expressed above are only what he esteems to be of the highest importance to agriculture.

The French Agricultural Experiment Station of the Centre is located at Clermont in Auvergne, and is in charge of Director Mr. P. Truchot. It was established in 1873, and has been in active and satisfactory operation ever since. It has a laboratory where fertilizers, soils, waters, &c., are analyzed—a field appropriated to experiments with different fertilizers on staple crops, agricultural teaching by public conferences with practical farmers—and by scientific investigations of important agricultural topics. The expenses of the station are met partly by the gifts of large farmers, partly by government aid, and to some extent by fees for analyses which are made at low prices.

In each of its departments important work is being done at the station. The peculiarities of the soil are coming to be better understood—fertilizers with guaranteed analyses are required—and results of analyses and experiment are published regularly. The experiment plots are planted from year to year with the same crops of beets, potatoes, barley, white wheat and red wheat, and fertilized with the same simple and mixed manures. The agricultural conferences have led to some successes in stopping the ravages of the *phylloxera* which has destroyed so many vineyards, and the chemical study of the soils and crops upon them, with other topics, are being constantly brought forward.

Clermont is the centre of an interesting agricultural industry. It is the manufacture of vermicelli, maccaroni and other alimentary pastes, as well as of semolina, or grits from the hard wheat grown in Auvergne. In 1855 this industry required one million one hundred thousand bushels of hard wheat, worth $1,400,000, and the amount is much exceeded now. Eighty establishments manufacture the grain, twelve or fifteen make the pastes, and of these a single one produces nearly two million pounds a year. The wheat from which this is made is grown without difficulty and without its degenerating. Wheat possessing the same properties is brought from Africa or from Southern Russia, if the home supply is deficient or fails. It is a very hard red wheat, bearded, and is not liked by the millers on account of its hardness and the dark color of the flour. The difference in its properties is due to its containing more gluten and less starch than the tender white wheats. They think the rich volcanic soils of Auvergne and the alluvial soils of Limogne

produce this remarkable variety. It is noticed too, that the temperature, and atmospheric circumstances, influence in a remarkable degree, the hardness of the grain. A hot sun striking the ripening grain after a light rain, ordinarily hardens it, and a change which follows high winds gives a like result. Sometimes a part of the grains only in the same field and even in the same head are hard and the others tender. The gluten varies from 16 per cent. in the hardest wheats down to 12 in the tender ones.

The wheat is ground between millstones, set so far apart that the grains are only cracked in small pieces, and not ground into flour. The wheat thus broken up is sifted and bolted and separated into—

Semolina, first quality	45	per cent.
Semolina, second quality	5	" "
Semolina flour	31.5	" "
Bran	17	" "
Waste	1.5	" "

Only one-half the weight of the grain is thus prepared for making the pastes. The Semolina is moistened with fifteen or twenty per cent. of warm water, according to the product to be made, maccaroni requiring a little the most; it is then kneaded in a round kneading-trough, which has a wooden bottom and in which a vertical millstone of considerable weight turns. A little saffron in solution is added to the paste to give it the proper color and odor. The paste is then put into a vertical metallic cylinder, where it is subjected to the pressure of a powerful screw or hydraulic press; and the bottom of the cylinder, which is called the mould, being pierced with holes of the shape of the product to be made, and the paste softened by the heat of steam circulating in the double sides of the cylinder, the maccaroni or vermicelli, which comes out in long strings, is cut in convenient lengths, and arranged to dry in proper form and at a temperature of 70° to 90° Far. The little pastes shaped like stars, letters, &c., are pressed out in the same way, but are cut off rapidly at the bottom of the mould by a revolving knife.

The greater nutritive value of this wheat and the industrial importance attached to it, makes it an object of interest to agriculturists.

The mean temperature of the year at Clermont is 50°. That for the winter temperature is 37° and the mean summer temperature is 64°, indicating a climate somewhat cooler and more equable than our own. The annual rain-fall is from sixteen to twenty-four inches, which is only about half as much as ours.

AGRICULTURAL TEACHING IN ITALY.

For the benefit of agriculture, two superior schools and twenty-one inferior have been established by the Italian Government. Only one, the superior school at Milan, was visited. It was established in 1870. The city and province of Milan joined in its support. Its objects are to complete the agricultural teaching which is given in the technical institutes and special schools, to prepare professors of agriculture, to give young men destined to agricultural life the theoretical and practical knowledge necessary for the successful management of farming operations, and to contribute to the progress of agriculture by experimental researches.

The school is governed by a council of direction of five members, of which council the director is the head. It has eleven professors, besides tutors and assistants. The course of study is three years, after which a diploma is given those who pass satisfactorily. The course of study comprises Italian literature, German language, and full courses of study in Natural History, Chemistry, Physics, Physiology, practical Geometry, Bookkeeping, Agriculture in all its branches, with excursions. At entrance, students bring a certificate of having passed through the lower government schools, or are subject to an examination equivalent to such a course of study.

Since the opening of the school it has received one hundred and eight students. Of these, forty-nine have gone out with the diploma after having completed the course; twenty-two have failed to get their diplomas; sixteen have left for various causes, and twenty-one are still in the Institution.

Of those who have gone out twenty are teachers of agriculture, nine are assistants at agricultural experiment stations, twenty-one are agriculturalists working their own lands, and three are managers of the estates of others.

The school receives for its support $18,000 yearly. It has very full and excellent collections in Natural History, agricultural products, implements and apparatus needed to illustrate the teachings of science, and good analytical laboratories. An experiment station is attached to the school, its object the study of soils, the chemical examination and practical determination of the value of various manures, experimental researches on the raising of cattle—the nutritive value of various kinds of feed—the microscopic examination of silkworm's eggs, the diffusion by publication and by conferences of the results of the experiments made.

This station formerly had its grounds in the limited space about the school buildings, but this Summer it was in process of change to more extensive grounds.

The introduction of improved agricultural processes in Italy

goes back only ten or fifteen years, but the change effected in this time is remarkable and encouraging. Italy differs from the rest of Europe in its milder climate and in the staple crops cultivated.

The following table gives the temperature in degrees Far. and the rainfall in inches:*

	TEMPERATURE, YEARLY AVERAGE.			Average annual Rainfall.
	Mean.	Highest.	Lowest.	
Milan	55.2°	97.3°	12.4°	30.15
Rome	59.5°	95.9°	21.2°	30.45
Naples	63.3°	....	....	35.28

The different crops cultivated, taking them in order according to the area devoted to them, are wheat, vines, Indian corn, olives, chestnuts, barley and rye, oats, beans, rice, hemp, flax. Mulberry trees are grown in fields which are partly occupied by other crops, so that land for silk production does not appear in the above list. Vines also are grown upon trees in cultivated fields, so that the area occupied by them seems to be too large for the product. The average crops per acre is reported as follows:

Wheat per acre in bushels	12.1
Indian corn per acre in bushels	29.1
Rice per acre in bushels	46.3
Barley and rye per acre in bushels	15.8
Oats per acre in bushels	20.6

Rice is cultivated mostly on irrigated land, and chiefly in Piedmont and Lombardy. More than three million acres of land are receiving the benefits of irrigation, and more than two million acres more are susceptible of this (treatment) improvement. This mode of improving land was begun in Italy more than six hundred years ago; but its progress has been slow on account of the magnitude and expense of the works necessary to begin it. The Cavour irrigation canal in Piedmont is said to be, including all its branches, five hundred miles long.

The live stock in Italy is disproportionately small, and the effect is seen in the lack of manure for enriching the ground, and in the small crops of grain.

AGRICULTURAL SCHOOLS AND EXPERIMENT STATIONS IN BAVARIA.

The Experiment Station at Munich has a good Chemical Laboratory, and is chiefly occupied in the study and analysis of

*The mean annual temperature at New Brunswick is 50.5° Far., the highest 97°, the lowest —12° and the annual rainfall 45.23 inches.

fertilizers. It was in charge of a director and assistant, and twenty-one students were in the Laboratory. They are admitted after two years or more in the preparatory institutions; and the course is continued here for two and a half years longer. The work done evidently meets a want felt by the farmers, and the number of analyses made is very large. Some experiments in cattle feeding were made here but they have been discontinued. In the experiment plots in the grounds, among other trials going on, was one on the growth of the soja bean (*Soja hispida.*) This is a leguminous plant which is cultivated as a forage plant in China and Japan. It was growing in a good garden soil, where it was planted about the first of May. At the end of July it had grown to a heavy mass of stems and leaves, and the pea-like seeds were full grown. As I saw it, the bean would make three or four tons of dry fodder to the acre, and it was thought to be a very promising addition to our stock of fodder plants.

Professor Haberland, of Vienna, noticed the seeds of the soja at the Vienna Exhibition among the productions of China and Japan. He first had the seeds examined chemically, and finding they contained an unusually large, and well proportioned amount of fatty and albuminous substances with their constituents, was encouraged to have it tried by farmers. In 1876 it was planted by twenty, and in 1877 by one hundred and thirty-five farmers; only in twelve cases did it fail to grow satisfactorily. The average crop of beans was two thousand six hundred pounds to the acre, and of straw, four thousand six hundred pounds. This year it was under trial in Bavaria and in other parts of Germany and with most flattering prospects of success; the quality and amount of the crop being all that was hoped for, and it is eaten most greedily by cattle.

THE ROYAL BAVARIAN CENTRAL SCHOOL OF AGRICULTURE AT WEIHENSTEPHAN.

This School was founded in 1852, and occupies the buildings and grounds of the old monastery of Weihenstephan. The faculty of instruction and direction of works consists of a director and twenty-two associates and assistants. During the year 1876–77 there were one hundred and thirty students in attendance, of whom fifty-seven were Bavarians, fifty-eight from other European countries and five from the United States. The regular course of study is for two years, and the school year is divided into a Winter and Summer term. This two years' course embraces Mathematics, Physics, Chemistry, Natural History, and the applications of these sciences in Agriculture. Book-keeping, Political Economy, History and Literature are also among the studies. Practical exercises in the laboratories, Surveying and Drawing, also enter the course. A technical course

designed more especially for those who are to engage in brewing. Particular stress is laid on practical work in the determination and analysis of plants, in the chemical examination of agricultural products and manures, and also of the materials employed in brewing. Horticulture and Forestry are taught by lectures and by practice in the pomological garden and in the forest park.

There is a preparatory course in agriculture which requires the students to labor on the school farm three and a half days a week. Alternate days and half days not given to work are devoted to elementary studies. This course is for one year, and makes a good preparation for the general (two years') course. The outdoor work is so arranged that each student becomes acquainted with all the practical operations of a farm.

For the practical work of the school a botanical garden, rich in the number and variety of plants, offers every facility to the student of plant structure and development. A garden of two and a quarter acres is given the students in the prepartory course; in it are grown all the staple, farm and vegetable crops, full accounts of the cost, condition and yield of each being kept by them.

The experiment field, also two and a quarter acres in extent, is devoted to experiments with crops and fertilizers, and may be called the Experiment Station.

An Arboretum was started in 1869. A chemical and physical laboratory, natural history collections, collections of models, &c., a library of eight thousand two hundred and forty-five volumes, and other appliances, furnish aid to the students.

Outside the experiment plots and gardens is a government farm of about eight hundred acres, which is under the direction of the head of the school. On this is a nursery, a brick-kiln, a distillery, a brewery and a gas establishment, all of which are managed for the benefit of the institution.

The farm is stocked with forty-six cows, two bulls and twenty young cattle, the cows are selected from the best specimens of the Swiss breed of brown Algauer cattle; four hundred merino sheep, and ten or twelve pigs. The team work for the farm, brewery, &c., is done by twenty horses and twelve oxen. The oxen are of the Swiss Simmenthal breed of red and white cattle.

The expenses of the school amount to $14,000 a year, and are met by an annual appropriation from the government of $5,550, by the fees of students, which are, for tuition per year, $25 for Bavarians and $50 for foreigners, and for other charges from $125 to $300 a year, and by the profits of the brewery, farm and other connected works. The largest profits are from the brewery, which heretofore has sold about two hundred and twenty thousand gallons yearly, but on account of the need for more money they are now allowed to make double that quantity. The dairy is very carefully managed, and the profits from the sales of milk,

butter, cheese, pig feed and calves are faithfully recorded. The cows weigh on the average one thousand one hundred and thirty-seven pounds, and the average daily yield of milk throughout the year is six and seven-tenths quarts. There is also considerable income from the pomological nursery.

The experiment field is laid out to be worked after a definitely arranged plan for sixteen or twenty years continuously, and is intended to prove the capabilities of the soil, the effect of different manures on various farm crops, and the results of rotation on the profits from these products.

The field has a gentle southwest slope, and is protected on the north and west by forest trees planted in 1863. It was cultivated in oats and barley in 1858, in red clover in 1859, wheat in 1860, beets and vetches dressed with stable manure and bone dust in 1861. wheat in 1862, oats in 1863, barley with superphosphate in 1864, clover in 1865–66, in which year it was laid out in plots. The soil is a heavy loam, and is composed principally of clay and micaceous quartz sand. It has a tendency to form a crust on the surface, which is injurious to the crops. Treated with acid, there is a perceptible effervescence, indicative of a small percentage of lime and magnesia.

The field needs drainage, on account of the clayey layers in the lower grounds and the homogeneous loam, which hinders the water from sinking to the gravel and sand strata, which in this formation alternate with clayey and loamy beds.

In one hundred parts of the air-dried fine earth there are—

Coarse sand	24.74	per cent.
Fine sand	30.66	"
Clayey	27.22	"
Finest clayey mass	17.38	"
	100.00	

The clayey character of the soil indicates little lime and magnesia and a considerable percentage of alkalies and silica, and it may be designated a hungry loam. It is less adapted to red clover than to a mixture of red clover and grass seeds.

An analysis of this soil treated with hydrochloric acid gave,

Phosphoric acid	0.219
Potash	.249
Soluble silica	.596

from which Liebig concludes that if these quantities of nutritive matter in the soil are in available condition, there are of phosphoric acid four hundred times, of potash seven hundred times, and of silicic acid one hundred and ninety times as much as is needed for a single wheat harvest.

The quality of the soil and its exposure are altogether favor-

able, and the plots are as large as can be worked by the spade, and their smallness is more likely to secure uniformity of composition. The whole field is about two and a quarter acres (one hundred thousand square feet), and the principal divisions are twenty feet square—the side plots are one-half that size. The ground is all dug by the same gardener to the depth of one foot.

There are five main divisions, in each of which the Norfolk rotation is carried out, viz: beets, oats, clover, wheat. Of the plots, I. is unmanured, II. is manured with stable manure, III. with mineral manures, IV. with mineral manures and stable manure, V. with mineral manure, stable manure, and ammoniacal manure. Each of the divisions contains the plots for the rotation, and each of them is represented four times, so that each division has sixteen plots of four hundred square feet each. These are arranged in such a way as to correct any inequalities of soil, tillage, or fertilization, by taking the average of the four plots instead of any single one.

The amount of fertilizers to be used is carefully calculated, taking for the basis of calculation the difference between the crops naturally yielded by the soil without manure, and the heaviest crops that can profitably be grown on the soil.

There are also various supplementary plots in which crops are grown continuously on the same plots, one set without manure, another set by the aid of nitrogenous manures only, still another set by the use of all the manures, &c.

These experiments are all in progress now, and the yearly products are regularly reported; but they have not been continued long enough to satisfy the purposes for which they were planned. When that is done they cannot fail to settle some very important practical questions.

FARM SCHOOL AT STRICKHOFNEUR, ZURICH, SWITZERLAND.

This is a small but well-managed institution, belonging to the canton of Zurich. It is located on a farm of about ninety-five acres, some two miles northeast of the town of Zurich. There are forty students attending, the buildings provided for them are sufficient for the boarding and school purposes, and there are outbuildings for the farm. There are a director and two teachers, besides a gardener, a surveyor, and lectures on veterinary science in addition. Students are admitted with a good common school education at the age of fifteen, and the course of study occupies two years.

They have three or four hours of study a day in summer, and six or seven hours in winter. They rise at half-past four o'clock, and all the time not devoted to study is filled up with farm work. The farm has plots for an agricultural experiment station, which is conducted by the Polytechnic School at Zurich. But nearly

all the land is devoted to productive farming, and is so managed as to produce the largest amount of milk and garden vegetables, to be sold in the town. Of the land, about forty acres are in permanent meadow and the rest under tillage.

The soil is of drift origin, and is a clay loam. The rotation followed is such as to bring in a clover crop once in eight or nine years. It is, as near as possible, the following:

1. Wheat.	5. Oats and Barley.
2. Beans.	6. Potatoes.
3. Wheat.	7. Oats and Barley.
4. Beans.	8. Clover for two or three years.

About an acre and a half of the land is in vineyard, and there is an apple orchard on the cultivated ground. The wine and cider from these are consumed by the students. The vegetable garden contains about one and a half acres; and five and a half acres are occupied with root crops.

The stock kept on the farm was twenty cows, two bulls and eight calves, three or four oxen, three horses, and twelve or fifteen pigs. The cows were of the large brown Swiss breed, and were particularly good. They were very carefully kept, and would weigh about twelve hundred pounds. Their average daily yield of milk, the year round, was between eight and nine quarts. Such cows were then worth from $120 to $160 each. The oxen were of the red and white Simmenthal breed of Swiss cattle. The pigs were a native breed, which is much slenderer and lighter built than our breeds.

This farm is well managed, and is said to pay its way. It was established in 1853, and has had four hundred and twenty four graduates, and the institution is doing good service to the canton. Some of its graduates hold positions of influence in the country.

The expenses of students from the canton are borne by the canton. Forty dollars a year are paid for the board and tuition of each student. Students from other cantons pay for themselves $96 a year, and foreigners, or students not Swiss, pay $100 a year. The instruction is limited to elementary studies, but it seems to meet the wants of the country.

BELGIAN STATE AGRICULTURAL INSTITUTE.

This establishment is located at Gembloux, on the Luxemburg Railroad, twenty-five miles southeast of Brussels. It occupies the buildings and part of the grounds of the old Abbey of that name. It was established in 1861, and has been in very successful operation ever since. Its object is to favor the progress of agriculture by giving large landowners, young men who have to cultivate estates, farmers and stewards, the scientfic

knowledge necessary to manage or work their lands profitably. Besides, it offers to those for whom an industrial or administrative business is open, an opportunity to acquire special knowledge in agriculture and the subjects relating to it. It fits them for the direction of sugar manufactories, distilleries, breweries, or for keeping accounts, for chemists in agricultural laboratories, for professors for teaching agriculture, and for directors of agricultural Experiment Stations.

It has an attendance of from seventy to ninety students, and a corps of five or six professors. The course of instruction occupies three years, and the subjects taught are mainly Mathematical and Scientific. They are well taught with the aid of good instruments and apparatus, convenient laboratories, and very extensive collections of objects of agriculture, technology and natural history. There are no literary studies taught. The students are not obliged to labor, but are required to inspect and describe all the operations of the school farm, and to visit and study the sugar factories, breweries, manure factories, drainage works, &c., of the neighborhood. The students who complete the full course, and sustain the required examination, receive a degree of agricultural engineer. There have been four hundred and eighty-one students at the Institute, and one hundred and eighteen diplomas have been granted. A most marked and gratifying success has attended the teachings of the institution. More than one hundred of the former students are now cultivating large farms, some in Belgium and others in foreign countries. Thirty of them are engaged in agricultural teaching. Agricultural experiment stations, sugar factories, breweries, distilleries, management of waters and forests, trade in grain and seeds, manufacture of agricultural implements and manures, occupy more than a hundred of those who have studied there; and in all those industries which offer an opening for educated men, they have made themselves conspicuous by their knowledge and the success which they have attained.

Students are admitted at the age of sixteen; and the annual expense for board, room-rent, and tuition is $140 a year for Belgians and $200 for foreigners. The expense for tuition alone is $60 a year for Belgians, and $80 for foreigners.

The farm connected with the Institute is intended for a model farm, conducted on business and scientific principles. No experiments are made upon it, and most careful and detailed accounts are kept of its operations, expenses, profits and losses. It contains one hundred and sixty-four and a half acres, of which about twenty acres are occupied by buildings, roads, exercise grounds, yards, &c., so that there are only one hundred and forty-four acres in productive crops. It is rented ground, and the yearly payment for it is $14.50 per acre.

To stock the farm, and carry on its operations, the Belgian Government gave it a capital of $11,447 in 1861. This was used in bringing the farm into productive work; and since that time all the net income of the farm, after paying its expenses, has been carefully invested and placed to its credit. Without farther government aid, the capital of the farm on the 30th of April, 1878, had grown to $35,777; the accumulated profits being $24,330, which is equivalent to more than 12 per cent. simple interest on the original capital. To obtain this result ordinary crops would not suffice, the production of the land has to be pressed to the maximum. At the very beginning the director of the farm adopted the principles laid down in Liebig's remarkable work, entiled "The Natural Laws of Agriculture." This demonstrates that whatever of mineral matters is removed from the farm in the crops or animals sold, must be returned to the soil in manures from without. This principle has been strictly adhered to, and every year an amount of commercial manures equivalent, in kind, to those sold off, has been purchased and brought on the farm. By this means, additional to the ordinary supplies from the farmyards, the land has been kept constantly increasing in richness and productiveness.

The leading crops sold from the farm are beets and wheat, and to these the attention of the director is chiefly turned. The rotation followed is, first year, beets, potatoes and carrots; second, wheat with clover; third, clover; fourth, wheat; fifth, beets; sixth, wheat. Half the land is in wheat every year, and one-third in beets. One-sixth is in clover. There are five acres in lucerne, and about seventeen acres in natural meadow. The average wheat crop of the farm in 1859 and 1860, was twenty-six bushels to the acre,—this average has been rising steadily under the present management, and the average crop is now from thirty-six to thirty-nine bushels per acre. The crop of sugar beets in 1860, was only four and a half tons per acre. Those of 1874 and 1875 were twenty tons per acre, and that of the mangold wurzel was more than thirty tons. The live stock on the farm consists of cows, of which about twenty-five head of Short-Horns are kept for butter making, a flock of two hundred and twenty sheep of the common breed, and South-Down rams; from which mutton, lambs and wool are sold; and a good number of large Yorkshire swine from which sales are made; and ten horses for the team work. The cost of labor is about $20 per acre, that of teams $10 per acre. The gross receipts of the farm are $64 an acre of the cultivated land.

The Institute, both in its teachings and its model farm, has attracted the attention of agriculturists in all parts of Europe, and students have come to it from all countries. For a number of years there were more foreigners in it than there were native Belgians. But it has gradually grown in favor with its own peo-

ple, and now there are twice as many Belgian students as there are of all other nations together. It is a lmirably situated in a healthy and rich country, surrounded by large farms, only a short distance from Brussels and Namur, and in easy communication by railroad with all parts of the kingdom. The buildings are large and admirably arranged for study and investigation, and the farm is so located and managed as to be always ready for use in illustration of the best system of farming. The scientific principles learned in the Institute are seen in their application to the tillage and enrichment of the soil, in the growth of crops and management of live stock. They can also follow the capital, expenses and income in all their details and changes, to the end ,where the largest profits may be obtained.

The changes effected here under the influence of new theories of agriculture, have had their influence on the agricultural practice of the whole country. The cultivators of beets and other industrial plants understand that they cannot expect from the crops and stock of their farm a sufficient amount of manure to keep up their fertility; they are compelled to buy the ammonia, phosphoric acid and potash needed to supply that sent off in the articles sold.

This influence of the Institute is felt and acknowledged throughout all Belgium, and to some extent in all countries where their students have gone. It is a source of honest pride to the Belgian farmers. A visit to the establishment and an opportunity to go through the various departments appropriated to instruction, as well as to inspect the farm and its appliances, gave us assurance that its usefulness is justly appreciated, and its high standing well earned. Provided with an introduction from the Minister of Agriculture, at Brussels, to M. Lejeune, Director of the Institute, we were well received, and the personal attention and explanations of the Director made the visit a most interesting and instructive one. The farm, in particular, is an admirable teacher of what can be done for agriculture, where skillful practice is guided by science.

At our visit there, I was much interested in the application of Liebig's formula for the production of artificial milk, which the Director had in successful operation. He explained and showed the materials and apparatus, and we saw the young animals that were fed on it. As it is a curious and yet a succesful application of chemical science to rural economy, I will give the process, as nearly as possible in the words of the Director who showed it to us.

A part of the farm economy is to keep a large stock of cows, and make butter. Another part, is to raise all the young calves and pigs that they can. Since 1867, the young animals have been raised on artificial milk, made from skimmed milk, *sus-*

picious milk, and buttermilk, to which they add wheat flour, malt and carbonate of potash.

It is admitted by all that the proper food for a young animal is its mother's milk. It is complete, containing all that is necessary for its early growth and development; it is easy of digestion, and no other substance is so well adapted to its delicate organization. Daily experience proves the truth of this opinion, and it is necessary that the young creature should have milk many weeks before it can be fed any amount of hay tea, cooked ground feed, &c. The chemical composition of flour, particularly of wheat flour, is such that it explains its injurious action on the health of young animals. It is acid in its reaction, it leaves after burning, acid phosphates which cannot furnish in digestion the amount of potash necessary for the formation of blood. These are the facts brought together by Liebig in investigating the cause of the mortality of infants in the mountainous parts of the Black Forest. This mortality reached in the first year of their lives 42 per cent., and was due, in part at least, to being fed on a cooked mixture of flour and milk.

On the farm when the milk fails, and its place has to be supplied by ground feed, oil cakes, &c., indigestion and diarrhœa come on, and the growth is never as complete as with pure milk, and it is preferable to diminish the number fed rather than to injure the most promising ones. Besides, it is rare that the mothers give enough milk to raise all the youug, and if it is desirable to fatten calves, it cannot be done when they get to be two or three months old, and require twenty or thirty litres* a day to supply their wants.

Artificial milk remedies this state of things. It enables the farmer to raise, and even to fatten, all the calves produced on a farm, and to increase the growth of the large number of pigs that are commonly kept at dairying establishments.

Liebig made a formula for the preparation of artificial milk, which experience proved to be a good one. In 1867 Liebig's formula, somewhat modified to suit our circumstances, was used at this institute in rearing calves. And in 1873, some time before the death of this illustrious chemist, he asked from us the details of the results we had attained with this food.

He had taken for the basis of his formula, the analysis of woman's milk, as made at Giessen by M. Harden—which in one thousand parts contained thirty-one of casein, forty-three of sugar of milk, and thirty-one of butter—and of cow's milk, skimmed, in which the casein and flesh-forming substances were to the sugar and butter, the heat-producing elements, as ten to twenty-five, or one to two and one-half. He used in preparing

* The French litre is a little more than our wine quart, and is less than the English imperial quart—the litre being sixty-one and one-third cubic inches, the wine quart fifty-seven and three-fourths inches, and the imperial quart sixty-nine and one-fourth inches. It avoids fractions, and is sufficiently accurate to call the litre a quart.

artificial milk for children, sixteen parts of wheat flour, one hundred and sixty parts of skimmed milk, sixteen parts of malt mixed in thirty-two parts of cold water, and three parts of a solution of bicarbonate of potash, made with eleven parts of water and two parts of bicarbonate.

Milk varies much in composition, in casein, sugar of milk, and in butter. The milk of different species of animals shows considerable variations. We have sometimes churned cow's milk which has given two and one-fifth pounds of butter for thirty-five quarts, though we get on the average two and one-fifth pounds for twenty-five quarts of milk. This is a difference of forty per cent. in butter only. It is not surprising, then, that the analyses of chemists should not agree. The following results, obtained as the averages in different places, will better enable a person to appreciate these variations:

ANALYSES OF PURE MILK.

Nutritious principles.	E. M. Wolf.	J. Kuhn.	Grouven & Settegart.
Azotized or flesh-forming substances	4.0 p. c.	4.0 p. c.	4.0 p. c.
Respiratory and heat-producing substances—hydro-carbons	8.3 p. c.	8.3 p. c.	8.4 p. c.
Total nutritious matter	12.3 p. c.	12.3 p. c.	12.4 p. c.
Relation of flesh-forming to respiratory subst'es	1 : 2.08	1 : 2.08	1 : 2.1

ANALYSES OF SKIMMED MILK.

Nutritious principles.	Wolf.	Kuhn.	Grouven & Settegart.	Lehman.
	Per cent.	Per cent.	Per cent.	Per cent.
Azotized or flesh-forming substances	4.0	3.2	4.0	3.6
Respiratory and heat-producing substances—hydro-carbons	3.2	6.2	5.4	5.2
Total nutritious matter	9.2	9.4	9.4	8.8
Relation of flesh-forming to respiratory substances	1 : 1.30	1 : 1.93	1 : 1.35	1 : 1.44

These analyses show that the total quantity of nutritious matters varies but little in the mean of different analyses, but it is not so of the relation between the flesh-forming and the respiratory constituents—Wolf putting it as 1 : 1.30, while Kühn makes it 1 : 1.93. Liebig took for his computations the analyses of Harden, made at Giessen, who found for skimmed milk the ratio to be 1 : 2.5, and for sweet milk that of 1 : 3. These vary too much for the means found by other chemists. M. Lejeune thought the analyses of MM. Grouven and Settegart could be taken for the

base of calculations. They are the ones used at Gembloux since 1867, and they can be recommended, as they have made the manufacture a success.

According to MM. Grouven and Settegart, sweet milk contains 4 per cent. of flesh-forming and 8.4 per cent. of heat-producing matters. It follows that if 3 per cent. of heat-producing matters are put into skimmed milk, it will have the same nutritive value as the sweet milk; but that it may properly serve for the nourishment of calves and other young animals, it is necessary that this 3 per cent. should be in a soluble form, easily digestible, neutral, and containing sufficient carb. potash to neutralize the acids and furnish the alkali needed for the formation of blood. The preparation must be made so as to change all the starch of the flour or meal into sugar or soluble dextrin.

At Gembloux they raise all their calves and a large number of pigs, and their management is as follows: The young calves receive for three weeks, eight quarts of their mother's milk a day, and the pigs are suckled for three weeks. After this they diminish progressively the mother's milk, and replace it by artificial milk.

The milk is prepared in this way: Suppose the quantity of skimmed milk to be made each day is one hundred quarts. According to Kuhn's analysis malted barley has 9.4 per cent. flesh-forming matters and 72.05 per cent. heat producing matters, and wheat flour 12 per cent. flesh-forming matters and 73.4 per cent. heat producing matters.

If to one hundred quarts of skimmed milk seven and three-quarter pounds of malt, and as much of flour are added, the mixture will contain in—

	Flesh forming.	Heat producing.
100 quarts of skimmed milk	141.2 oz.	190.0 oz.
$7\frac{3}{4}$ pounds of malt	11.6	89.5
$7\frac{3}{4}$ pounds of flour	14.8	90.7
	167.6 oz.	370.2 oz.

This mixture consequently contains, in round numbers, one hundred and sixty-eight ounces, or ten and a half pounds of flesh-forming substance, and three hundred and seventy ounces, or twenty-three and one-eighth pounds of heat-producing substance, and the relation of the two is 1 : 2.2. If the mixture corresponds to sweet milk, it should contain the same materials in the same proportion. Now one hundred quarts of sweet milk contains only one hundred and forty-one and two-tenths ounces —eight and three-quarter pounds—of flesh-forming and two hundred and ninety-six and four-tenths ounces, or eighteen and

five-eighths pounds of heat-producing matters; so that sixteen quarts of water can be added to the mixture to make it of the composition of good milk, and it will then be one hundred and sixteen quarts of liquid, containing 4.09 per cent. of flesh-forming, and 9.05 per cent. of heat-producing matters. In making it they weigh for a quart of skimmed milk five hundred and forty grains* of wheat flour, five hundred and forty grains of malt flour, and fifteen and a half grains of carbonate of potash.

The flour and carbonate of potash are mixed in a kettle, and little by little cold water is kneaded with it till the mass is thoroughly mixed and diluted with fifty-six ounces, or one and three-quarter quarts of water. At Gembloux is used a steaming apparatus, made by Richmond & Chandler, Salford, Manchester, England. They pour into the stationary kettle of this apparatus the skimmed milk, and add to it the mixture mentioned above, being careful to mix it with a wooden spatula; then they let on a jet of steam, which thoroughly stirs the whole mixture. In a few minutes, when the temperature has risen to 155° or 160° Fah., they raise the lid, and stir the mixture till it begins to thicken. Then they turn off the steam, and stir for about five minutes, or until the mixture has become smooth and thin, like cream. Then the steam is turned on again, and if the mixture still thickens the steam is stopped, and the stirring repeated, and this is done several times if necessary. After about twenty minutes of rest it is heated again, and the temperature allowed to rise to boiling. After a few minutes of boiling, the artificial milk is prepared, and only needs to be left to cool, when it is ready to feed to the calves. It can be kept twenty-four hours in Summer, and longer in Winter. It has been prepared in this way ever since 1867 with perfect success. Attempts have been made to prepare it by the heat of the fire, but they have not been successful on account of the difficulty of hindering the thickened flour from adhering to the bottom of the kettle. The steam apparatus is perfectly manageable, and it is probably essential to the process.

Wheat flour has a very marked acid reaction, and its acids are neutralized by means of bicarbonate of potash. But they use the carbonate because it is much cheaper. It cannot be replaced by carbonate of soda, for potash is necessary to the formation of blood. In making the milk, it is necessary to be sure that the acids are neutralized. This is ascertained by using test-paper, and if potash enough has not been added, a little more must be put in, till the test-paper remains blue.

In the artificial milk, the starch of the flour is completely transformed into sugar and dextrin. If the starch had to be transformed into sugar in the stomach of the young animal, it would impose on its delicate organization a labor which it is

*An ounce is four hundred and thirty-seven and a half grains, and a pound seven thousand grains.

spared by the transformation in the preparatory work described above; and it is this which explains the use of malt, the repeated stirrings, and the stopping of the heat (when it has reached the temperature of 155° or 160° Fah.) so as to hinder the coagulation of the starch.

This milk forms a sweet, nourishing, easily digestible and wholesome food, which fully takes the place of natural pure milk in rearing and fattening calves and pigs.

As to the cost, it is, at Gembloux, in comparison with sweet milk, as follows:

100 quarts of skimmed milk	$0.80
7¾ pounds of malt	28
7¾ pounds of common flour	21
Carbonate of potash	2
Coal	4
Total	$1.35

This is about 1.1 cents a quart, which is less than half the value of sweet milk, as they use it in making butter. As we saw them making the milk, they were using some cheap rice flour, which cost them considerably less than their wheat flour was worth.

A visit to some of the *Holland polders* made an interesting part of our trip. These flat lands, which were formerly wet and continually liable to overflow, have been embanked, ditched, and the water pumped out, and they are now among the most productive lands in the world. The banks are made so high and solid that water does not leak through them or rise above them in storms; and the surface is intersected by ditches which receive all the rainfall and conduct it to places along the banks, where it is raised by windmill or steam pumps into sluices, from which it passes into the sea. In this way the land is kept dry, and as the soil is a very fine loam and full of organic matter, it is rich and productive. The condition of the soil in relation to water causes it to be better adapted to growing grass than to cultivated crops, and most of the land is in meadow and pasture. The clearings of the ditches are used to dress the lands, and barnyard manures are also applied for top dressings. Very little, if any, other fertilizers are used.

The cattle kept on these grounds are very numerous: it appeared as if there were as many as one to every acre, and a gentleman near Purmerend told me he kept two cows and two sheep for every *bunder* (two and one-half acres) of land he occupied. This, of course, only supplies the hay and pasture. Feed is bought in the markets. Cows for the dairy are the leading stock, but great numbers are fattened for beef, and many sheep are kept for raising lambs and for making mutton.

The cattle are of the peculiar black and white breed, which has been kept there for ages, and which has been bred mainly for dairy purposes. They are very large, the cows weighing from twelve hundred to sixteen hundred pounds, and are noted for giving more milk than any other breed. The milk is especially rich in cheese, and the dairies are much more for making cheese than for butter. Cheese has long been a staple product in Holland, but this year American cheese of unexceptionable quality was selling in Purmerend, a large cheese market, at prices lower than those at which the Holland cheese could be afforded. The cows are much higher priced than ours, and large numbers of them are sent to other countries where good dairy cattle are sought. We saw some remarkably fine ones in the dairy at Gennvilliers, near Paris, and excellent ones have been brought to this country at different times. Some of the best in North Holland were selected at our visit, and were bought by Mr. James Neilson, and they are now on his farm adjoining the College Farm at New Brunswick.

The sheep are large, and resemble the long-wool breeds of English sheep.

The inexhaustible fertility of the land in Holland has been the source of its prosperity and wealth in recent times, and though the expense of reclaiming such wet lands is very great—much more than land is worth in our country—still they go on with the work. The project for draining the southern end of the Zuider Zee, which includes an area of seven hundred and fifty square miles, or four hundred and eighty thousand acres, is now matured, and the capital required can readily be obtained, so strong is the confidence which has been gained by the success of similar works heretofore undertaken. The water averages eleven feet deep, and it will require steam engines of nine thousand four hundred horse power working steadily four and a half years to take out all the water; and the total expense for pumps, dikes, canals, interest, &c., will amount to more than $70,000,000, or about $150 an acre. But the land is considered to be worth more than that, and the improvement will be made. Farming is always profitable on land naturally fertile, even when the price of it is high.

AGRICULTURAL EDUCATION IN IRELAND.

Much attention is given to this subject in Ireland, and it is under the direction of the Commissioners of National Education. The Albert National Agricultural Training Institution, at Glasnevin, near Dublin, is the central institution, and there are numerous smaller ones in various parts of the country. A visit to Glasnevin and the model farm in August, when the harvest was in progress, was very interesting. The farm and school buildings

are about three miles north of Dublin, and a mile from the village of Glasnevin. It was begun in 1838, so that it is now well organized and in regular and systematic working. Its object is to supply such instruction, both in the science and practice of agriculture, as will qualify young men as agricultural teachers, land-stewards, farmers, &c. There is a farm of one hundred and eighty acres, and on it are buildings to lodge and board seventy students and their teachers, and to furnish the necessary rooms for teaching, illustrations, &c.

Forty of the students are boarded, lodged and educated at the public expense for two years. They are admitted half-yearly, after competitive examination, are from all classes of society. Any well conducted young men are eligible, whether educated at the national schools or others. They must be seventeen years of age, in good health, and of good moral character. Thirty students are received who conform to the regulations of the Institution and pay $150 a year for their expenses. The instruction includes all the branches of a sound English education, namely: English Grammar and Composition, Arithmetic, Book-keeping and Mathematics, including Land Surveying, Leveling and Mapping. And that the students may become fully acquainted with improved practical husbandry, they are called upon to take part in every farm operation—the feeding and management of live stock, &c. They are also made practically acquainted with the use of a large collection of farm implements and machines.

The school is full, and its graduates are taking prominent positions in Irish agriculture. The prizes for the best managed farms in the country, for the last two years have been taken by men who studied here.

The model farm is conducted in the most skillful and economical manner, so as to make it an example of improved and profitable farming. Of the one hundred and eighty acres of land, five acres are in a farm to be worked by spade husbandry; twenty-five acres in a farm to be worked by one horse, and the remaining one hundred and fifty acres are worked with the most approved appliances, and under a carefully considered system which experience has shown to be adapted to their circumstances and location. A strict account is kept of all sales and expenses, and whatever is supplied to the school is charged the same as to other purchasers.

The leading product is milk, which is sold to customers in Dublin, and the cropping of the farm is arranged so as to obtain the largest possible amount. The soil is on limestone, and is rather heavy; it is all underdrained. It is divided up so that two fields at the extreme ends of the farm, containing together about fifty acres, are in permanent pasture, and eight other fields, of ten or eleven acres each, which are cropped in rotation.

The rotation at present is—

1. Oats on sod.
2. Mangolds.
3. Wheat, and seeded to Italian rye and perennial grasses.
4. Hay.
5. Potatoes.
6. Turnips.
7. Barley seeded to rye grass and clover.
8. Hay.

The barnyard manure is all used on the mangolds and turnips, and $500 worth of chemical manures is bought annually. The artificial manure used is a mixture of one part nitrate of soda, two parts Kainite, and two parts superphosphate of lime. There is a reservoir over the barnyard, into which all the liquid manure is pumped, and from this it is conducted through pipes to the middle of each pasture field, and there distributed through proper hose-pipe over the pasture.

The crops of wheat, oats and barley were very heavy; but with the peculiarities of Irish weights and measures, we fear an error in trying to put them into ours. The mangolds were very promising, and were their best root crop. The pasture was extraordinarily thick and heavy.

In addition to student labor, $2,000 a year is paid for the regular hired labor, which includes that of two post graduate students who act as foremen in the fields; and the annual expense for implements and repairs is $600.

Eight horses are kept, two are heavy team horses, two are mares which do lighter work and raise colts, one does the work of the twenty-five acre farm, two are used for the milk wagons, and one for a hack; forty-five milk cows, one bull, and a very few young cattle are kept. The cows are all grade Short-horns, bought when fresh at the country fairs. They buy the best offered, paying from $90 to $120 a head, keeping them fat, and selling to the butcher as soon as they cease to yield paying quantities of milk. They are kept in the richest of pasture, and the oats, barley and mangolds of the farm are fed to them in the season, and brewers' grains are bought in addition. The cows average from eight to ten imperial quarts a day the year round, and the milk is sold at the consumers' doors in Dublin at eight cents a quart in summer and ten cents in winter. Five imperial quarts are equal to six of our wine quarts. The sales of milk last year were $8,585.

Sheep are not bred on the farm. In autumn they buy about fifty ewes, winter them well, raise and market their lambs early, shear and fatten the sheep, and market the wool and mutton as early as possible, generally in June. The sheep they prefer are the large Irish Roscommon and a Leicester ram. These sheep are very hardy, generally have twin lambs, give a large quantity of milk, so that the lambs are well fattened. The lambs are about a week longer in maturing for the early market than

South Downs, but they are so much more numerous, larger and hardier that they are more profitable. The store sheep last year cost $13 50-100 and sold for $16 25-100, and sixty-four lambs sold for $8 each. The wool, which weighed about eight pounds a fleece, was sold for thirty-one cents a pound.

The swine raised are the large Yorkshires and Berkshires. The former have been kept for twenty years past; the latter have been introduced more recently. There are three breeding sows and a boar of each breed, and about fifty pigs. Many of the pigs are sold for breeding. Pigs sell from $11 to $15 per one hundred and twelve pounds.

The careful and intelligent supervision of this farm in all its management and economies is well shown in the returns. The farm is leased at $20 an acre, yearly rent; the stock, implements, &c., used in carrying it on make up a capital of $12,500. Last year the balance left after paying rent and all other expenses was $4,300, which is over 34 per cent. on the capital. It has not been as large as this every year, but it has been very large for many years past.

The working of this farm is well worthy of study, and we regret we had not more time to devote to it. There are many circumstances which contribute to its peculiar advantages. The soil is very rich—the capital to carry it on is all that is needed—it has been well conducted so long that is has a well-established and high character; it is very near one of the best marke —no unproductive land, stock, or capital of any kind is kept. Everything relating to the farm and its economies is subjected to public and most intelligent criticism.

It may be said that they get a considerable profit from the student labor, but this cannot amount to very much, as they pay out besides this over $11 an acre for hire, and the labor on the best managed English farms is only from $8 to $10 an acre.

Tiptree Hall Farm—Alderman Mechi's, near Kelvedon, Essex, England, is a remarkable specimen of the English system of improved and intensive farming. The farm contains one hundred and seventy acres, and has been owned and cultivated by the present occupant since 1841. It is on the geological formation, known as the London clay, and until recently was a part of Tiptree Heath. The soil is mostly a tough, heavy clay, naturally wet and springy in wet seasons, and excessively hard in dry ones. He has drained the whole with deep tile drains, and the soil is still so tough that it has to be ploughed and cultivated in ridges. By high manuring, thorough and deep cultivation, and skillful management, the farm, for many years, has been made to pay 12½ per cent. on all the capital employed, after paying all expenses and allowing $10 an acre for the rent of the land. $80 an acre of capital is invested in stock, implements, labor, and

unsold feed and products. His crops are very large. Wheat averaging between forty and fifty bushels per acre, and in some cases amounting to sixty-four bushels per acre; his mangolds amount to thirty-five and sometimes to forty tons per acre, and the crops of oats, beans, tares, cabbage, red clover and Italian rye grass, are very heavy. The stock consists of thirty to forty bullocks, about two hundred sheep and three hundred fowls.

The work is done with horses, as he does not consider his farm large enough to work with steam. He has, however, a six-horse steam-engine, which is used for cutting up straw, bean-stalks, &c., for fodder, in driving a grain and feed mill, a threshing-machine and a force-pump. The pump is used for pumping up water to wash down the manure from the cattle pens into a large cistern, and then in forcing this liquid manure through pipes to the middle of the several fields, where it is sprinkled over the surface by means of hose-pipe. Most of the manure is put on the fields in this way. Sheep are kept on the fields to be manured, and thus most of the labor usually expended in hauling manure is saved. Most of the cattle pens are floored or sparred with strips of wood and openings between, on which the animals are kept without bedding, and the manure is washed down to a passage below from which it runs into the manure cistern. He values barnyard manure higher than commercial fertilizers, and increases the amount of it by keeping the largest possible number of bullocks and sheep, feeding them with straw and coarse fodder produced on the farm, and buying oil-cake and other feeding stuffs for fattening them.

Mr. Mechi's balance sheet for 1875, the last one published, will give some idea of the expenses, receipts and profits of an English farm. It is reprinted in pounds, shillings and pence, as in the original; but those who prefer can change it to dollars and cents, by allowing $5 for a pound, twenty-five cents for a shilling, and two cents for a penny.

Balance Sheet, 1875.

	1875. £ s. d.
January 1—Valuation:	
Live stock	901 2 0
Poultry	25 0 0
Horses and donkey	265 0 0
Tillages, manure, &c.	510 14 9
Hay, corn, &c., (unsold)	621 15 0
Implements*	465 11 6
	2,789 3 3
Payments.	
Corn and hay for live stock, produce of farm, charged at market prices	69 0 0
Corn, cake, malt-culms, bran, &c., purchased for live stock	456 17 0
Grinding corn for live stock by our own engine, at the usual prices charged to others	17 0 0
Veterinary	0 7 0
Medicals	2 0 0
Live stock purchased	245 2 0†
Horse food purchased from farm	47 10 0
Ditto purchased elsewhere	105 0 0
Farm labor, including engine-driver and working bailiff	446 11 0
Rent of Chapel land, 45 acres	56 0 0
Tithes, taxes, poor, highway, church and county rates	88 12 5
Reserve for wear and tear and depreciation of machinery and implements	25 0 0
Coals for steam-engine	50 0 0
Tradesmen's Bills:—Wheelwright, blacksmith, founder, harness-maker, bricklayer, carpenter, painter, basket-maker, cooper	63 2 9
Malt and hops for beer for laborers	18 11 8
Seeds and plants purchased	25 4 11
Ditto of our own growth	64 0 0
Purchased manures	99 17 11
Miscellaneous Petty Expenses:—Mole and rat-catching, mending sacks, postage stamps, stationery and farm account books, oil, candles, cart-grease, tallow, packing for engine	12 19 9
Thatching	11 0 11
Thatching stuff	1 6 4
Hired steam ploughing	49 15 0
Ditto threshing work	16 12 0
Grinding corn at our own mill for our farm horses	8 15 0
Fire insurance	3 15 0
Hail-storm insurance	2 4 0
	4,775 7 11
December 31—Valuation:	
Live stock	847 5 0
Poultry	30 0 0
Horses and donkey	250 0 0
Tillages, manure, &c.	560 16 11
Corn and hay, &c., (unsold)	409 9 0
Implements	465 11 6
	2,563 2 5
Receipts.	
Corn sold for money	744 16 6
Corn and hay sold to live stock, as per contra	69 0 0
Peas (picked for market) sold, after deducting all expenses	258 12 9
Home-grown corn used as seed, and charged per contra	64 0 0
Oats, beans and hay, home grown, sold to our horses and charged per contra	47 10 0
Hay and straw sold	461 14 0
Mangel roots and seeds sold	4 6 6
Fat meat sold	913 17 8
Wool sold	60 13 6
Poultry and eggs sold	43 15 6
Grinding for hire	31 13 0
Grinding for own stock	17 0 0
Grinding for horses, as per contra	8 15 0
Rent of cottages	16 4 0
Received for sundries	0 10 0
	5,305 10 10
Paid	4,775 7 11
Balance for rent of 128 acres and profit and interest on 173 acres	530 2 11‡

* The fixed steam-engine, irrigation pumps, millstones and threshing machine are valued in the estate.
† This includes the value of ten ewes and ram presented to me by the Midland Farmers' Club.
‡ This balance is £159 6*s.* 11½*d.* less than that of 1874, owing to blight on wheat and barley.

The visits made to the places mentioned in the notes, were very interesting and suggestive to the writer, and it is hoped they may prove profitable to farmers. It would not be proper, however, to transplant the systems or processes of foreign countries to our own without important modifications. Land is higher priced in Europe than in America. and farm wages much lower. Working animals, meat and wheat cost more there than here, while coarser grains and vegetables cost less. Most of the land is in large farms, on which there is a farmer or steward and many common laborers, while with us the farms are smaller and the owner and his family, in most cases, do the work themselves. There are many other points of difference in the condition of the people, in which we should undoubtedly like our own best. So that instruction drawn from there must be in the way of hints rather than in full directions.

Improvements in agriculture are going forward there as fast as with us. We excel them in most implements and labor-saving machines, while they excel us in the production and management of fertilizers and in thorough and skillful tillage. Agricultural education and the application of science to agriculture are everywhere receiving attention, both from individuals and from governments. In the eduction of the young the methods pursued are as various as the countries in which they have originated. It is probable they will finally assimilate more to each other, and to other schools in which mathematical, physical and chemical sciences are well and practically taught, and where the various departments of Natural History are made important branches of study. The student well grounded in these may be safely left to choose such a calling as best suits his taste and circumstances.

The establishment of Agricultural Experiment Stations, however, has met with approval everywhere, and they are in successful operation in all the countries of Europe. The benefits from them are received at once, and so universal is the want of the information they supply, that new ones are established every year.

Public acknowledgement should be made of the favor shown at all the places visited, and of the pains taken to furnish all the information asked for. The pleasure and the profits of the visits throughout have been greatly increased by the company and aid of my friend James Neilson, Esq., of the Board of Visitors of the Agricultural College.

Courses of Study.

Three distinct courses of study are included in the Schedule which follows:

I. A Course in Civil Engineering and Mechanics.

II. A Course in Chemistry and Agriculture.

III. A Special Course in Chemistry.

During the first and second year the studies of the two full courses are the same, and are designed to furnish a suitable introduction to the pursuit of the higher branches in either.

During the last two years the subjects of Higher Mathematics, Mechanics and Engineering in the Engineering Course are replaced by Analytical Chemistry, practice in the Laboratory, and Agriculture in the other. The remaining subjects are pursued by the students of both courses together.

The course of study for the first two years in this Department is arranged so as to be complete in itself. It is especially designed to meet the wants of those who cannot take the entire four years' course, but who desire to fit themselves as Land Surveyors. Students leaving at this period of the course, receive from the Faculty a certificate of their attainments.

Special Students are received, and allowed to take any part of the above course; and particular provision is made for them, especially in the Laboratory, in Mathematics and Surveying.

The Special Course in Chemistry and Agriculture, occupying two years, is designed for those who wish to devote themselves exclusively to these branches. Opportunities of a very superior character are afforded to such students under the charge of Professors Cook, Smock, Van Dyck and Austen in the new Laboratory building.

Special provision is also made for students who desire, after completing the regular course of study, to take post-graduate studies.

COURSE OF STUDY.

FRESHMAN YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. French. 2. Mathematics—Loomis' Algebra, from Quadratic Equations. 3. Natuaral History—Dalton's Physiology; Lectures. 4. Rhetoric—Haven; Lectures. 5. Draughting—Construction of Problems in Plane Geometry.

SECOND TERM.

1. French. 2. Mathematics—Loomis' Geometry, from Book IV. 3. Natural History—Zoology; Lectures. 4. Elocution—Lectures. 5. English Literature—Shaw's Manual; Craik's English of Shakespeare. 6. Draughting—Coloring, Topographical Signs, &c.

THIRD TERM.

1. French. 2. Mathematics—Loomis' Trigonometry, Plane and Spherical. 3. Natural History—Gray's Botany; Lectures. 4. English Literature—Shaw's Manual; Lectures. 5. Draughting—Mapping, with Sections, &c.

SOPHOMORE YEAR.

Exercises during the year in Compositon and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Surveying—Murray's Manual; Field Exercises and Mapping. 2. Descriptive Geometry—Church. 3. Chemistry—Lectures. 4. Mental Philosophy—Haven. 5. History—Freeman's Outlines. 6. Draughting—Practical Geometry, solid.

SECOND TERM.

1. Descriptive Geometry—Church; Construction of Problems. 2. Chemistry—Lectures. 3. Mental Philosophy—Haven. 4. History—Freeman's Outlines. 5. Intersection of Surfaces, &c.

THIRD TERM.

1. Leveling and Railroad Curves—Henck's Field Book; Field Practice and Plotting. 2. Shades, Shadows and Perspective—Church; Construction of Problems. 3. Chemistry—Lectures. 4. Mental Philosophy—Lectures. 5. History—Creasy's Constitutional History of England. 6. Shades and Shadows and Linear Perspective.

JUNIOR YEAR.

Exercises during the year in Composition and Original Declamation Bible Class each Sabbath morning.

Course in Civil Engineering and Mechanics.

FIRST TERM.

1. German. 2. Analytical Geometry—Peck. 3. Natural Philosophy—Snell's Olmsted. 4. History of Civilization—Guizot. 5. Constitutional History of the United States—Text book and Lectures. 6. Draughting—Lettering, &c.

SECOND TERM.

1. German. 2. Differential and Integral Calculus—Peck. 3. Natural Philosophy—Snell's Olmsted. 4. Political Economy—Bowen and Perry. 5. Constitutional History of the United S ates—Text book and Lectures. 6 Draughting—Shading, &c.

Course in Chemistry and Agriculture.

FIRST TERM.

1. German. 2. Mineralogy and Analytical Chemistry--Text book, with Laboratory Practice. 3. Agriculture—Lectures at the Farm. 4. Natural Philosophy—Snell's Olmsted. 5. History of Civilization—Guizot. 6. Constitutional History of the United States—Text book and Lectures.

SECOND TERM.

1. German. 2. Analytical Chemistry — Text book, with Laboratory Practice. 3. Agriculture—Lectures. 4. Natural Philosophy — Snell's Olmsted. 5. Political Economy—Bowen and Perry. 6. Constitutional History of the United States—Text book and Lectures.

THIRD TERM.

1. German. 2. Mechanics—Bartlett or Smith. 3. Astronomy—Loomis. 4. International Law—Woolsey. 5. Draughting—Constructions.

THIRD TERM.

1. German. 2. Analytical Chemistry—Text book, with Laboratory Practice. 3. Agriculture—Vegetable Physiology. 4. International Law—Woolsey.

SENIOR YEAR.

Exercises during the year in Composition and Original Declamation, Bible Class each Sabbath morning.

Course in Civil Engineering and Mechanics.

FIRST TERM.

1. Mechanics — Bartlett or Smith. 2. Geodesy — Theory and Practice of Triangulation. 3. Chemistry—Lectures on Organic Chemistry. 4. Moral Philosophy — Wayland and Hopkins. 5. Draughting—Machinery and Architecture.

SECOND TERM.

1. Engineering — Mahan. 2. Geodesy—Practical Astronomy; Indeterminate Analysis. 3. Chemistry—Lectures on Chemical Physics. 4. Moral Philosophy—Butler's Analogy. 5. Draughting—Engineering.

THIRD TERM.

1. Engineering—Bridge Building and Railway Practice. 2. Architecture—Lectures. 3. Geology — Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy. 5. Draughting—Theses.

Course in Chemistry and Agriculture.

FIRST TERM.

1. Mining and Metallurgy. 2. Chemistry and Principles of Agriculture—Lectures. 3. Laboratory Practice. 4. Moral Philosophy — Wayland and Hopkins.

SECOND TERM.

1. Agriculture—Its Methods and Products. 2. Chemistry—Lectures on Chemical Physics. 3. Laboratory Practice. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Agriculture—Animal Physiology; Care and Management of Domestic Animals. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

SPECIAL COURSE IN CHEMISTRY.

FIRST YEAR—FIRST TERM.

1. Elements of Chemistry—Text book and Lectures. 2. Blowpipe Analysis. 3. Elements of Mineralogy.

SECOND TERM.

1. Physics and Chemistry—Text book and Lectures. 2. Chemical Analysis—Qualitative.

THIRD TERM.

1. Chemical Analysis—Qualitative and Quantitative. 2. Vegetable Physiology.

SECOND YEAR—FIRST TERM.

1. Chemical Analysis—Analysis of Minerals, Ores, &c. 2. Mineralogy—Determinative.

SECOND TERM.

1. Chemical Physics—Heat, Electricity, Magnetism, Galvanism and Electro-magnetism—Text book and Lectures. 2. Analysis of Fertilizers and Chemical Products.

THIRD TERM.

1. Lectures on Geology. 2. Chemical Analysis—Special Investigations.

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